

# **SUMMER CHUM SALMON CONSERVATION INITIATIVE**

**An Implementation Plan  
to Recover Summer Chum in the  
Hood Canal and Strait of Juan de Fuca Region**

*Supplemental Report No. 4*  
**Report on Summer Chum Salmon Stock Assessment  
and Management Activities for 2001 and 2002**

**Washington Department of Fish and Wildlife  
Point No Point Treaty Tribes**

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# ***1 - INTRODUCTION***

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## ***BACKGROUND***

The Washington Department of Fish and Wildlife and Point No Point Treaty Tribes distributed the Summer Chum Salmon Conservation Initiative (SCSCI) in April 2000 (WDFW and PNPTT 2000). The initiative described a comprehensive implementation plan for the recovery of summer chum salmon in Hood Canal and eastern Strait of Juan de Fuca.

The SCSCI specifies preparation of periodic reports that describe the results of plan implementation and assess compliance with and effectiveness of the plan provisions (section 3.6.2 of SCSCI). A report, providing updated information and data for the first two years (1999 and 2000) following the completion of SCSCI, was made available by the Co-managers in 2001 (WDFW and PNPTT 2001). The following is the second report, applicable to the years 2001 and 2002. The topics addressed include stock assessment, harvest management, artificial production, ecological interactions, and habitat; subjects that correspond to the major areas of management activities required to address comprehensive recovery of the summer chum as described in the SCSCI. A concluding remarks section is provided at the end of the report.

## ***UPDATED INFORMATION***

This report focuses on summer chum salmon information and data for the past two years, 2001 and 2002. It also provides corrections where applicable for previous years, based on new information and found errors. For this reason, the historical information of this report takes precedence over that previously reported.



## 2 - STOCK ASSESSMENT

### ESCAPEMENT

Spawning ground surveys were conducted throughout the summer chum return period to estimate the abundance of summer chum spawners for all known stocks in the Hood Canal and Strait of Juan de Fuca summer chum region during 2001 and 2002. In addition, the Co-managers conducted escapement surveys that will provide information to determine and monitor the status of Dungeness River summer chum salmon, whose status is currently unknown.

Escapement estimates for the 2001 and 2002 returns of summer chum salmon are summarized in Table 1, and regional escapement estimates for the period 1974-2002 are presented in Table 2 and Figure 1. Summer chum spawning escapement estimates for the period 1968 through 2002 are provided for the Hood Canal and the Strait of Juan de Fuca regions in Appendix Tables 1 and 2, respectively. Information on the number of fish taken for broodstock by each supplementation program is also included.

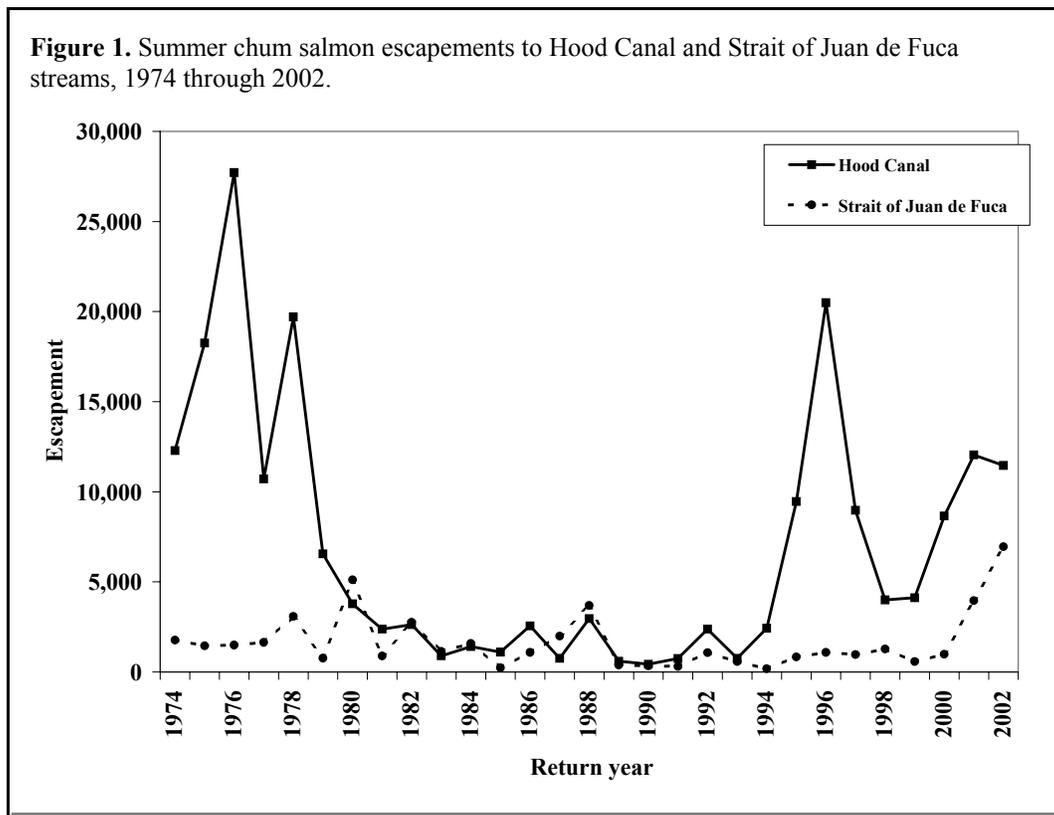
<b>Stock/stream</b>	<b>2001</b>	<b>2002</b>
<b>Hood Canal Region</b>		
Big Beef Creek	894	742
Anderson Creek	0	0
Dewatto River	32	10
Tahuya River	0	0
Union River	1,491	872
Lilliwaup Creek	92	858
Hamma Hamma River	1,227	2,328
Duckabush River	942	530
Dosewallips River	990	1,627
Big Quilcene River	6,174	4,017
Little Quilcene River	199	470
<b>Hood Canal Region Total</b>	<b>12,041</b>	<b>11,454</b>
<b>Strait of Juan de Fuca Region</b>		
Chimacum Creek	903	864
Snow Creek	154	532
Salmon Creek	2,638	5,517
Jimmycomelately Creek	260	42
<b>Strait of Juan de Fuca Region Total</b>	<b>3,955</b>	<b>6,955</b>

Detailed spawning escapement summaries for each stock during 2001 and 2002 are provided in Appendix Report 1. The methods used to estimate escapements are the same as described in SCSCI Appendix Report 1.1 (WDFW and PNPTT 2000), and the current information is presented in the same format as in the appendices to Supplemental Report No. 1 of the SCSCI (Haymes 2000). This report includes summaries for the Big Beef, Chimacum, and Dungeness stocks that were absent in the SCSCI. Survey data from several small streams not previously included are also presented here (Little Anderson, Seabeck, Stavis, Harding, Thomas, Eagle, Jorsted, and Fulton creeks). Some of these streams were identified as possibly being part of the

historic distribution of summer chum salmon based on evidence of evidence of former summer chum occurrence, but insufficient evidence to determine whether each represented a distinct stock (see SCSCI 1.7.2.3, WDFW and PNPTT, 2000). These streams were also monitored to determine if summer chum are re-colonizing these streams and/or if summer chum adults returning from supplementation programs may be straying into these watersheds. Brief discussions of the 2001 and 2002 summer chum salmon escapements follow.

<b>Table 2.</b> Escapement for Hood Canal and the Strait of Juan de Fuca summer chum salmon stocks, 1974-2002. Numbers in <i>bold italics</i> represent new or corrected numbers.			
<b>Return year</b>	<b>Hood Canal escapement</b>	<b>St. of Juan de Fuca escapement</b>	<b>HC/SJF combined</b>
1974	12,281	1,768	14,049
1975	18,248	1,448	19,696
1976	27,715	1,494	29,209
1977	10,711	1,644	12,355
1978	<b>19,709</b>	3,080	<b>22,789</b>
1979	6,554	761	7,315
1980	3,777	5,109	8,886
1981	2,374	884	3,258
1982	2,623	2,751	5,374
1983	899	1,139	2,038
1984	1,414	1,579	2,993
1985	1,109	232	1,341
1986	2,552	1,087	3,639
1987	757	1,991	2,748
1988	2,967	3,690	6,657
1989	598	388	986
1990	429	341	770
1991	747	309	1,056
1992	2,377	1,070	3,447
1993	756	573	1,329
1994	2,429	178	2,607
1995	<b>9,462</b>	839	<b>10,301</b>
1996	20,490	1,084	21,574
1997	8,972	962	9,934
1998	<b>4,001</b>	1,269	<b>5,270</b>
1999	4,114	573	4,687
2000	8,649	983	9,632
2001	<b>12,041</b>	<b>3,955</b>	<b>15,996</b>
2002	<b>11,454</b>	<b>6,955</b>	<b>18,409</b>

**Figure 1.** Summer chum salmon escapements to Hood Canal and Strait of Juan de Fuca streams, 1974 through 2002.



## 2001 ESCAPEMENTS

The estimated spawning escapement of summer chum to Hood Canal streams in 2001 was 12,041 fish, substantially higher than the 2000 total. The majority of escapement occurred in the major streams entering the west side of Hood Canal. The Big Quilcene River again experienced a good spawning run (6,174 fish). This return originated from fish produced in part by hatchery supplementation efforts, however, a significant portion of the spawners were natural origin recruits (see discussion of marked fish recoveries below). The Little Quilcene total of 199 spawners was an indication of an increasing escapement trend for this population. The Duckabush and Hamma Hamma escapements were up substantially from the 2000 escapements; the 2001 escapements were 942 and 1,227 fish, respectively, while Dosewallips was somewhat lower than the previous year with 990 fish. Lilliwaup Creek showed improvement, with 92 summer chum returning to spawn in 2001. The eastern Hood Canal streams again showed no evidence of any significant returns, with the exception the Big Beef Creek and Dewatto River. Big Beef Creek experienced a return of 894 summer chum spawners, the direct result of a re-introduction project using eggs from the Quilcene stock. Dewatto had an escapement of 32 summer chum spawners, the largest escapement since 1984. The Union River escapement was very strong in 2001 (1,491 fish).

In the Strait of Juan de Fuca, Salmon Creek experienced a strong escapement of 2,638 fish in 2001 (progeny of natural spawning and an on-going supplementation program), and Snow Creek and Jimmycomelately escapements showed substantial improvement (154 and 260 fish, respectively). Chimacum Creek experienced a very encouraging return with an escapement of

903 fish in 2001 (the result of an on-going reintroduction project). Thirteen surveys were conducted on the lower Dungeness River between July 23 and Oct. 31, 2001. Only one live and one dead chum salmon were observed in the lower Dungeness (on October 9<sup>th</sup>) during the 2001 season, however, a total of 10 summer chum were observed during partial counts at a pink salmon brood stocking weir, indicating that the minimum 2001 escapement was 10 fish (not shown in Table 1).

## **2002 ESCAPEMENTS**

The estimated spawning escapement of summer chum to Hood Canal streams in 2002 was 11,454 fish. Again, the majority of escapement occurred in the major streams entering the west side of Hood Canal. The Big Quilcene River experienced a good escapement (4,017 fish). As in the years since the 1994 return, this spawning population originated from a mix of natural and supplementation program produced fish, and supplementation fish continue to make up a significant portion of the returning spawners. The Little Quilcene River spawner numbers increased this year to 470 fish, the highest escapement since 1978 (Appendix Table 1). The Dosewallips, Duckabush, and Hamma Hamma rivers had good spawner abundance in 2002 (1,627, 530, and 2,328 fish, respectively). Lilliwaup Creek escapement showed a great rebound related to supplementation efforts, with 858 summer chum spawners, the largest return since 1978. The eastern Hood Canal streams again showed no significant escapements, except for continued returns from the Big Beef Creek reintroduction project (742 fish). Also, ten summer chum were observed in the Dewatto (contributing to a 54 fish total over the last 4 years), suggesting that natural re-colonization is occurring. The Union River's escapement was good in 2002 (872 fish), continuing an upward trend observed in recent years.

In the Strait of Juan de Fuca for 2002, Salmon Creek experienced an escapement of 5,517 fish (progeny of natural spawning and an on-going supplementation program), and Snow Creek experienced an improved return of 532 fish. Jimmycomelately escapement was low (42 fish). Escapement to Chimacum Creek was 864 fish, encouraging evidence that the on-going re-introduction project on that stream is having success. Ten surveys were conducted on the lower Dungeness River between Aug. 5 and Oct. 7, 2002, and only one live chum was observed (not shown in Table 1).

## ***RUNSIZE***

To determine the total numbers of salmon returning to specific production areas, fish that are harvested in mixed stock and terminal fisheries must be allocated to the streams from which they originated. This allocation is done through a post-season process called "run re-construction," which splits the harvests in each catch area into the numbers of fish that were likely contributed by the individual stocks or management unit thought to be transiting the area. All estimated harvests for each stock or management unit are added to the escapement for that grouping to derive the estimated total return for each year. A number of corrections have been made to the run re-construction tables reported in the SCSCI, so up-dated tables for the years 1974 through 2002 are presented in Appendix Report 2. A discussion of the run re-construction methodology can be found in the SCSCI Appendix Report 1.3.

## 2001 RUNSIZES

The estimated 2001 summer chum runsize in Hood Canal was 13,375 fish, with 13,274 fish entering the terminal area (Table 3). The Strait of Juan de Fuca returns in 2001 totaled 3,982 summer chum salmon, 3,955 of which entered the terminal area. The combined summer chum return to the Hood Canal/Strait of Juan de Fuca region was 17,357 fish during the 2001 season (Table 4).

## 2002 RUNSIZES

For the year 2002 returns, the summer chum runsize of Hood Canal stocks was 13,151 fish, with 13,105 summer chum entering the terminal area (Table 3). The returns of Strait of Juan de Fuca summer chum totaled 6,980 fish in 2002, with a terminal area runsize of 6,955 fish. The Hood Canal/Strait of Juan de Fuca region had a combined summer chum total runsize of 20,131 fish during the 2002 return year (Table 4).

<b>Table 3.</b> Regional summer chum salmon runsizes during the 2001 and 2002 return years.		
<b>Runsize category</b>	<b>2001</b>	<b>2002</b>
<b>Hood Canal Region</b>		
Escapement	12,044	11,454
Terminal runsize	13,274	13,105
<b>Hood Canal total runsize</b>	13,375	13,151
<b>Strait of Juan de Fuca Region</b>		
Escapement	3,955	6,955
Terminal runsize	3,955	6,955
<b>Strait of Juan de Fuca total runsize</b>	3,982	6,980

**Table 4.** Total runsizes for Hood Canal and the Strait of Juan de Fuca summer chum salmon stocks (1974-2002). Numbers in *bold italics* represent new or corrected values.

Return year	Hood Canal runsize	Strait of Juan de Fuca runsize	HC/SJF combined
1974	<i>14,222</i>	1,985	<i>16,207</i>
1975	<i>29,113</i>	<i>1,747</i>	<i>30,860</i>
1976	<i>74,220</i>	1,673	<i>75,893</i>
1977	<i>16,689</i>	1,810	<i>18,498</i>
1978	<i>25,344</i>	3,240	<i>28,584</i>
1979	9,513	900	10,413
1980	<i>13,026</i>	5,574	<i>18,600</i>
1981	<i>5,875</i>	<i>1,139</i>	<i>7,014</i>
1982	<i>8,331</i>	<i>3,540</i>	<i>11,871</i>
1983	<i>3,545</i>	<i>1,217</i>	<i>4,762</i>
1984	<i>3,372</i>	<i>1,707</i>	<i>5,079</i>
1985	<i>4,424</i>	<i>411</i>	<i>4,835</i>
1986	7,832	1,217	9,049
1987	<i>3,971</i>	2,181	<i>6,152</i>
1988	<i>5,680</i>	<i>4,129</i>	<i>9,809</i>
1989	<i>4,473</i>	795	<i>5,268</i>
1990	<i>1,564</i>	<i>528</i>	<i>2,092</i>
1991	<i>2,199</i>	<i>424</i>	<i>2,623</i>
1992	<i>3,378</i>	1,394	<i>4,770</i>
1993	871	643	1,514
1994	<i>2,959</i>	214	<i>3,173</i>
1995	<i>9,984</i>	882	<i>10,866</i>
1996	<i>21,056</i>	1,106	<i>22,162</i>
1997	9,373	985	10,358
1998	4,274	1,316	5,590
1999	<i>4,527</i>	577	<i>5,104</i>
2000	<i>9,506</i>	<i>987</i>	<i>10,493</i>
2001	<i>13,375</i>	<i>3,982</i>	<i>17,357</i>
2002	<i>13,151</i>	<i>6,980</i>	<i>20,131</i>

## ***GENETIC STOCK IDENTIFICATION (GSI)***

During 2001 and 2002, the Co-managers continued GSI allozyme and/or DNA collections of summer chum spawners throughout the region (Tables 5 and 6). Analysis of the collected data, over time, will allow the comparison of recent and past allozyme collections with the goal of monitoring changes in allelic characteristics and of assessing whether the supplementation programs have negatively affected the genetic diversity of natural populations. Three new genetic analyses of summer chum allozyme and DNA collections have recently been completed.

Kassler and Shaklee (2003) examined recently collected allozyme data for summer chum salmon populations in Hood Canal and Strait of Juan de Fuca and compared the new data with previously collected allozyme data. A total of 43 collections from 12 locations were statistically analyzed to assess population interrelationships and to see if the allele frequencies of any of the populations had changed over time. The results indicated that the currently recognized summer

chum stocks generally are significantly different from each other. Only one stock, Dosewallips, showed a significant difference over time; that is, between allozyme collections in 1992 and 1998. The 1992 collection was significantly different from other stocks, whereas, the 1998 collection was not significantly different from other stocks, excepting those of Union and Lilliwaup. The underlying cause for the 1992 to 1998 difference at Dosewallips is not yet apparent but may be better understood with data collection and analysis for additional years. The complete paper is attached as Appendix Report 3.

Small and Young (2003) reported on the genetic analysis of summer and early fall chum salmon populations in Hood Canal, Strait of Juan de Fuca, and South Puget Sound using microsatellite DNA. They found allele frequencies at 13 microsatellite loci separated chum salmon DNA collections into four groups that correlated with geography and run-timing. Summer chum of Hood Canal formed a group distinct but associated with summer chum of the Strait of Juan de Fuca. These two groups were shown to be distinct from Hood Canal fall chum and from South Puget Sound chum. It appears that, by using microsatellite DNA analysis, individual fish can be assigned to their group of origin and components of a mixed stock fishery may be identified in future studies. The complete paper is attached as Appendix Report 4.

The SCSCI summer chum Base Conservation Regime requires that all chum salmon be released in the Washington Catch Area 7 Reef Net fishery between the dates of August 1 and September 30 (SCSCI Section 3.5.6.1, page 309). This restriction was based on the possibility that summer chum might be present, however, no stock identification studies had been conducted in the area during the specified time period. During the 2002 season, 200 chum salmon samples were collected from the Area 7 Reef Net fishery during two weeks, starting on September 21 and ending September 29, 2002. Standard allozyme GSI analyses were conducted by the WDFW Genetics Lab, and the results were reported by Kassler (2003).

“Allozyme-based maximum likelihood estimates of stock contributions to this fishery were calculated .... Twenty-five loci were screened for the analysis and a 60 stock baseline was used. Results of this analysis revealed the highest portion of the catch was from Fraser River stocks (56.6%). Three other stock groups (North Puget Sound Fall, Georgia Strait, and West Coast Vancouver Island) contributed between 13.2 and 9.3% of the catch while the estimates for Hood Canal Summer chum and Strait of Juan de Fuca Summer chum were only 4.4% ( $\pm 4.2$ ) and 2.1% ( $\pm 4.2$ ), respectively. ... Although the Hood Canal summer chum and the Strait of Juan de Fuca summer chum group estimates were non-zero and positive, neither was significantly greater than zero. Therefore, this analysis provides no compelling evidence that any chum from the Hood Canal summer run ESU were harvested in this fishery.”

Otoliths were also collected from the same 200 fish sample of Area 7 chum salmon, and were analyzed by the WDFW Otolith Lab. Of the total sample, 194 had readable otoliths, and none of these fish had marked otoliths. Given the otolith marking of summer chum from most supplementation projects, the lack of marks tends to support the conclusion that Hood Canal and Strait of Juan de Fuca summer chum salmon were not present in Area 7 in 2002.

## BIOLOGICAL DATA (AGE, SIZE, AND SEX DATA)

The scale collections made from summer chum salmon in eastern Strait of Juan de Fuca and Hood Canal streams during 2001 and 2002 are shown in Tables 5 and 6. Age composition determined from the scale collections are presented in Table 7 for 2001 and Table 8 for 2002.

Information is also available on the size (fork length) and sex ratio for each stock each year, but those data have not been summarized.

**Table 5.** Genetic, otolith, and scale collections made from adult summer chum salmon in eastern Strait of Juan de Fuca and Hood Canal streams, 2001.

Stream	WRIA	GSI code	Sample size				Collection method
			Allozyme	DNA	Otoliths	Scales	
Dungeness R.	18.0018	--	0	1	0	2	Spawner survey
Jimmycomelately Cr. <sup>1</sup>	17.0285	01GJ	86	104	119	124	Trap, spawner survey
Salmon Cr. <sup>1</sup>	17.0245	01GK	0	0	272	272	Trap, spawner survey
Snow Cr.	17.0219	01GL	0	30	51	58	Spawner survey
Chimacum Cr. <sup>1</sup>	17.0203	01GM	0	0	98	132	Spawner survey
Thorndyke Cr.	17.0170	--		1	0	2	Spawner survey
Little Quilcene R.	17.0076	01GN	0	1	79	79	Spawner survey
Big Quilcene R. <sup>1</sup>	17.0012	--					
Spawner escapement			0	0	0	358	Spawner survey
Broodstock			0	0	0	311	Seine in bay, rack
Total			0	0	0	669	
Dosewallips R.	16.0442	01GO	0	47	0	131	Spawner survey
Duckabush R.	16.0351	01GP	0	57	0	147	Spawner survey
Fulton Cr.	16.0032	--	0	1	0	1	Spawner survey
Hamma Hamma R. <sup>1</sup>	16.0251	01GV	0	56	112	114	Seine, spawner survey
Lilliwaup R. <sup>1</sup>	16.0230	01GW	0	55	72	72	Trap, spawner survey
Union R. <sup>1</sup>	15.0503	01GX	85	85	0	143	Trap, spawner survey
Stavis Cr.	15.0404	--	0	0	0	1	Spawner survey
Dewatto R.	15.0420	--	0	0	0	3	Spawner survey
Big Beef Cr. <sup>1</sup>	15.0389	01HB	68	121	171	173	Trap, spawner survey
Little Anderson Cr.	15.0377	--	0	0	4	10	Spawner survey
<b>Totals</b>			<b>239</b>	<b>559</b>	<b>978</b>	<b>2,802</b>	

<sup>1</sup> Stream has supplementation or reintroduction program.

**Table 6.** Genetic, otolith, and scale collections made from adult summer chum salmon in eastern Strait of Juan de Fuca and Hood Canal streams, 2002.

Stream	WRIA	GSI code	Sample size				Collection method
			Allozyme	DNA	Otoliths	Scales	
Catch Area 7		02KQ	200		194		Reef net
Dungeness R.	18.0018	--	0	0	0	0	Spawner survey
Jimmycomelately Cr. <sup>1</sup>	17.0285	02IM	0	30	51	51	Trap, spawner survey
Salmon Cr. <sup>1</sup>	17.0245	02JA	0	0	419	460	Trap, spawner survey
Snow Cr.	17.0219	02IN	0	25	81	81	Spawner survey
Chimacum Cr. <sup>1</sup>	17.0203	02JB	0	0	191	390	Spawner survey
Thorndyke Cr.	17.0170	--	0	0	0	0	Spawner survey
Little Quilcene R.	17.0076	02JC	0	0	69	116	Spawner survey
Big Quilcene R. <sup>1</sup>	17.0012	--					
Spawner escapement			0	0	0	122	Spawner survey
Broodstock			0	100	0	236	Seine in bay, rack
Total			0	100	0	358	
Dosewallips R.	16.0442	02IO	0	0	127	207	Spawner survey
Duckabush R.	16.0351	02IP	0	0	80	108	Spawner survey
Fulton Cr.	16.0032	--	0	0	0	0	Spawner survey
Hamma Hamma R. <sup>1</sup>	16.0251	02IQ	0	80	180	190	Seine, spawner survey
Lilliwaup R. <sup>1</sup>	16.0230	02IR	0	88	144	146	Trap, spawner survey
Little Lilliwaup	16.0228	--	0	0	2	2	Spawner survey
Union R. <sup>1</sup>	15.0503	--	0	0	0	96	Trap, spawner survey
Stavis Cr.	15.0404	--	0	0	0	0	Spawner survey
Dewatto R.	15.0420	--	0	0	0	2	Spawner survey
Big Beef Cr. <sup>1</sup>	15.0389	02JD	0	62	199	211	Trap, spawner survey
Little Anderson Cr.	15.0377	--	0	0	0	0	Spawner survey
<b>Totals</b>			<b>200</b>	<b>485</b>	<b>1,542</b>	<b>2,776</b>	

<sup>1</sup> Stream has supplementation or reintroduction program.

**Table 7.** Age composition for summer chum salmon sampled from eastern Strait of Juan de Fuca and Hood Canal streams, 2001.

Stream	WRIA	GSI Code	Number sampled	Age composition from scale samples								Total no. aged <sup>2</sup>
				Age 2		Age 3		Age 4		Age 5		
				No.	%	No.	%	No.	%	No.	%	
Dungeness R.	18.0018	--	2	0	0.0%	1	50.0%	1	50.0%	0	0.0%	2
Jimmycomelately Cr. <sup>1</sup>	17.0285	01GJ	124	1	0.8%	93	75.0%	30	24.2%	0	0.0%	124
Salmon Cr. <sup>1</sup>	17.0245	01GK	272	12	4.4%	116	42.6%	144	52.9%	0	0.0%	272
Snow Cr.	17.0219	01GL	58	0	0.0%	34	64.2%	19	35.8%	0	0.0%	53
Chimacum Cr. <sup>1</sup>	17.0203	01GM	132	0	0.0%	63	49.2%	65	50.8%	0	0.0%	128
Thorndyke Cr.	17.0170	--	2	0	0.0%	1	50.0%	1	50.0%	0	0.0%	2
Little Quilcene R.	17.0076	01GN	79	2	2.6%	40	51.9%	34	44.2%	1	1.3%	77
Big Quilcene R. <sup>1</sup>	17.0012	--										
Spawner escape.			358	0	0.0%	84	24.6%	247	72.2%	11	3.2%	342
Broodstock			311	0	0.0%	102	33.2%	200	65.1%	5	1.6%	307
Total			669	0	0.0%	186	28.7%	447	68.9%	16	2.5%	649
Dosewallips R.	16.0442	01GO	131	0	0.0%	59	45.4%	54	41.5%	17	13.1%	130
Duckabush R.	16.0351	01GP	147	0	0.0%	47	32.4%	90	62.1%	8	5.5%	145
Fulton Cr.	16.0332	--	1	0	0.0%	0	0.0%	0	0.0%	1	100.0%	1
Hamma Hamma R. <sup>1</sup>	16.0251	01GV	114	0	0.0%	27	27.6%	60	61.2%	11	11.2%	98
Lilliwaup R. <sup>1</sup>	16.0230	01GW	72	3	5.2%	33	56.9%	21	36.2%	1	1.7%	58
Union R. <sup>1</sup>	15.0503	01GX	143	1	0.8%	2	1.6%	122	97.6%	0	0.0%	125
Stavis Cr.	15.0404	--	1	0	0.0%	1	100.0%	0	0.0%	0	0.0%	1
Dewatto R.	15.0420	--	3	0	0.0%	3	100.0%	0	0.0%	0	0.0%	3
Big Beef Cr. <sup>1</sup>	15.0389	01HB	173	1	0.6%	146	84.4%	26	15.0%	0	0.0%	173
Little Anderson Cr.	15.0377	--	10	0	0.0%	10	100.0%	0	0.0%	0	0.0%	10

<sup>1</sup> Supplementation or reintroduction program.

<sup>2</sup> Difference between "No. of scales sampled" and "Total no. aged" is number of unreadable or regenerated scale samples.

**Table 8.** Age composition for summer chum salmon sampled from eastern Strait of Juan de Fuca and Hood Canal streams, 2002.

Stream	WRIA	GSI Code	Number sampled	Age composition from scale samples								Total no. aged <sup>2</sup>
				Age 2		Age 3		Age 4		Age 5		
				No.	%	No.	%	No.	%	No.	%	
Dungeness R.	18.0018	--	0	0		0		0		0		0
Jimmycomelately Cr. <sup>1</sup>	17.0285	02IM	51	0	0.0%	47	97.9%	1	2.1%	0	0.0%	48
Salmon Cr. <sup>1</sup>	17.0245	02JA	460	0	0.0%	355	77.7%	101	22.1%	1	0.2%	457
Snow Cr.	17.0219	02IN	81	0	0.0%	62	76.5%	19	23.5%	0	0.0%	81
Chimacum Cr. <sup>1</sup>	17.0203	02JB	390	2	0.6%	140	38.7%	210	58.0%	10	2.8%	362
Thorndyke Cr.	17.0170	--	0	0		0		0		0		0
Little Quilcene R.	17.0076	02JC	116	0	0.0%	84	72.4%	27	23.3%	5	4.3%	116
Big Quilcene R. <sup>1</sup>	17.0012	--										
Spawner escape.			122	0	0.0%	80	67.8%	34	28.8%	4	3.4%	118
Broodstock			236	0	0.0%	201	86.6%	25	10.8%	6	2.6%	232
Total			358	0	0.0%	281	80.3%	59	16.9%	10	2.9%	350
Dosewallips R.	16.0442	02IO	207	0	0.0%	100	48.8%	89	43.4%	16	7.8%	205
Duckabush R.	16.0351	02IP	108	0	0.0%	68	63.6%	35	32.7%	4	3.7%	107
Fulton Cr.	16.0332	--	0	0		0		0		0		0
Hamma Hamma R. <sup>1</sup>	16.0251	02IQ	190	0	0.0%	149	79.7%	33	17.6%	5	2.7%	187
Lilliwaup R. <sup>1</sup>	16.0230	02IR	146	0	0.0%	129	89.6%	15	10.4%	0	0.0%	144
Little Lilliwaup R.	16.0228	--	2	0	0.0%	2	100.0%	0	0.0%	0	0.0%	2
Union R. <sup>1</sup>	15.0503	--	96	9	9.6%	66	70.2%	16	17.0%	3	3.2%	94
Stavis Cr.	15.0404	--	0	0		0		0		0		0
Dewatto R.	15.0420	--	2	0	0.0%	0	0.0%	1	50.0%	1	50.0%	2
Big Beef Cr. <sup>1</sup>	15.0389	02JD	211	3	1.5%	142	69.3%	59	28.8%	1	0.5%	205
Little Anderson Cr.	15.0377	--	0	0		0		0		0		0

<sup>1</sup> Supplementation or reintroduction program.  
<sup>2</sup> Difference between "No. of scales sampled" and "Total no. aged" is number of unreadable or regenerated scale samples.

## MARK RECOVERY

Summer chum fry from all supplementation and reintroduction programs are differentially marked to allow for differentiation from natural-origin fish upon return as adults in fisheries, at broodstock traps, and on the spawning grounds. For the supplementation program on Big Quilcene River, all fry have been adipose-fin-clipped beginning with brood year 1997. The summer chum released from all other supplementation programs have their otoliths thermally mass-marked at the embryo stage. Examination of otoliths recovered from spawned adults or checking adults for presence/absence of adipose fins provides a method to separate the number of supplementation (hatchery) fish from the number of naturally spawning fish and assists in determining the contribution of the supplementation program to the summer chum population. In addition, adipose-fin-clipping and otolith-marking make it possible to determine the level of straying of supplementation program-origin fish to other drainages.

Marked summer chum adults produced in the supplementation or reintroduction programs began returning to streams mostly during 2000, 2001, and 2002; the exceptions are Salmon Creek which had marked adults returning beginning in 1996 and Union River which will not have program returns until 2003 (Table 9). The numbers of summer chum salmon sampled for fin-clips or otoliths during 2001 and 2002 in eastern Strait of Juan de Fuca and Hood Canal streams are shown in Tables 5 and 6.

**Table 9.** Brood years that summer chum salmon supplementation or reintroduction programs and mass marking of fry releases (otolith marking or adipose clipping) were initiated in Hood Canal and eastern Strait of Juan de Fuca streams; and the first year marked adults from the programs are expected to return.

Supplementation or reintroduction program	Brood year program initiated	Brood year mass marking initiated	First year marked adults expected to return <sup>1</sup>
Salmon Cr.	1992	1993	1996
Big Quilcene R. <sup>2</sup>	1992	1997	2000
Lilliwaup Cr.	1992	1997	2000
Chimacum Cr.	1996	1999	2002
Big Beef Cr.	1996	1998	2001
Hamma Hamma R.	1997	1997	2000
Jimmycomelately Cr.	1999	1999	2002
Union R.	2000	2000	2003

<sup>1</sup> First year of returning age 3 fish is shown. Most adults return as ages 3 and 4, with perhaps a few at ages 2 and 5.

<sup>2</sup> Adipose-clip.

Otoliths were collected from adult summer chum salmon returning to spawn in Hood Canal and eastern Strait of Juan de Fuca streams and the fish were examined for adipose fin clips by WDFW, USFWS and tribal staffs, and staff or volunteers from Hood Canal Salmon Enhancement Group (HCSEG), Long Live The Kings (LLTK), North Olympic Salmon Coalition (NOSC) and Wild Olympic Salmon (WOS). Adult summer chum were sampled after spawning on the spawning grounds and/or after being spawned as broodstock for the supplementation/reintroduction programs. Otolith analyses were conducted by WDFW's Fish Program Otolith Laboratory.

Both the number of fish and the number of streams sampled increased from 2000 through 2002 as marked adults were expected to return from more supplementation programs, and additionally, more streams without supplementation programs were sampled. The actual numbers of otolith-marked or adipose marked (AD-clipped) adults sampled were expanded based on the percentage of the total spawner escapement sampled for otolith marks or AD-clips in each stream. The expanded estimates probably improve as the percentage of the total escapement sampled increases. The actual and expanded numbers of otolith-marked summer chum adults recovered in Hood Canal and eastern Strait of Juan de Fuca streams are presented in Tables 10, 12, and 14 for 2000, 2001, and 2002, respectively. The actual and expanded numbers of AD-clipped adults recovered are presented in Tables 11 and 13 for 2001 and 2002, respectively. No confidence intervals are presented in the tables and it is recommended that the reader uses caution in interpreting the limited data. Note that these expansions were based on total numbers of fish sampled, mainly for ease of presentation here. Calculating expansions based on age-specific otolith mark data would yield slightly different results, since age composition of otolith sampled fish varied slightly from total stock age composition in most cases .

Tables 10 through 14 are organized to show, for otolith marks or adipose (AD)-clips:

- 1) the actual numbers (top portion) and expanded numbers (bottom portion) of otolith-marked or AD-clipped adults recovered in each stream;
- 2) the actual and expanded numbers of otolith-marked and AD-clipped summer chum from each supplementation program at each recovery location (the numbers with gray shading represent adults recovered in the watershed(s) of the supplemented stock and the unshaded numbers are adults of that program recovered in other streams. Note that in the case of two stocks, adults return to two adjacent watersheds; the Quilcene stock to the Big and Little Quilcene rivers, and the Snow/Salmon stock to Snow and Salmon creeks);
- 3) the actual and expanded percent of adult recoveries that are either unmarked or are marked as supplementation fish from the same watershed (meaning they are not from another watershed's supplementation program) - shown at the ends of the rows for each recovery location ;
- 4) the total percentage of otolith or AD-clip recoveries which occurred in the supplementation stock's watershed - shown at the bottom of the column for each supplementation program;
- 5) for adipose clips, the actual and expanded numbers of recoveries are shown by age;
- 6) for adipose clips, the clipping efficiency (expanded estimates of supplementation fish also include an adjustment to compensate for clip efficiency less than 100%); and
- 7) for all recovery locations combined, the total percentage of otolith recoveries which occurred in the supplementation stock's watershed(s) - shown in the footnotes.

Finally, the reader should also use caution when referencing any of these tables on its own. In one stream in 2001 (Little Quilcene) and several streams in 2002, ad-clipped and otolith-marked individuals were recovered in the same stream. In these cases, the otolith expansions are based on non-ad-clipped escapement only, since ad-clipped individuals were not sampled for otolith marks. Also, ad-clip or otolith data alone do not completely describe numbers of supplementation origin fish recovered for these streams. Consult the text following the tables for discussion of total mark recoveries in streams where both types were recovered.

**Table 10.** Actual (top table) and expanded (bottom table) numbers of otolith-marked summer chum salmon adults recovered in Hood Canal and eastern Strait of Juan de Fuca streams, **2000**. Otolith-marked fry are released from supplementation programs for several summer chum stocks. The actual numbers sampled were expanded based on the percentage of the total spawner escapement sampled for otolith marks. The numbers in gray shading represent adults recovered in the supplemented stock's watershed (s); unshaded numbers are adults recovered in other streams.

Actual numbers sampled, 2000 - otoliths		Supplementation program				Total otoliths readable	Total escapement	% unmarked + % same-stock supplementation
		Unmarked	Big Beef Cr	Lilliwaup Cr	Hamma Hamma			
<b>Ages marked (2000 return)</b>			2	2-3	2-3	2-5		
<b>Recovery location</b>	<b>WRIA</b>							
Lilliwaup Cr	16.0230	4	1			5	22	80%
Hamma Hamma	16.0251	46			2	48	229	100%
Little Quilcene	17.0076	18				19	268	95%
Chimacum Cr	17.0203	19 <sup>1</sup>				10	52	66%
Snow Cr	17.0219	2				1	30	100%
Salmon Cr	17.0245	90				84	846	100%
Jimmycomelately Cr	17.0285	53				53	55	100%
<b>Total otoliths read</b>		232	1	0	2	96	331	
Expanded numbers, 2000- otoliths		Supplementation program				% escapement sampled for otoliths	Total escapement	% unmarked + % same-stock supplementation
		Unmarked	Big Beef Cr	Lilliwaup Cr	Hamma Hamma			
<b>Ages marked (2000 return)</b>			2	2-3	2-3	2-5		
<b>Recovery location</b>	<b>WRIA</b>							
Lilliwaup Cr	16.0230	18	4			23%	22	82%
Hamma Hamma R	16.0251	219			10	21%	229	100%
Little Quilcene R	17.0076	254				7%	268	95%
Chimacum Cr	17.0203	34 <sup>1</sup>				18	52	65%
Snow Cr	17.0219	20				10	30	100%
Salmon Cr	17.0245	438				408	846	100%
Jimmycomelately Cr	17.0285	55				96%	55	100%
<b>Expanded total</b>		1,038	4	0	10	450	22%	1,502
% of expanded otolith recoveries in watershed(s) of supplemented stock <sup>2</sup>			NA	--	100%	93%		

<sup>1</sup> Fish from Chimacum Creek reintroduction program were unmarked until 1999 brood. Unmarked fish recovered in 2000 were likely Chimacum reintroduction origin. <sup>2</sup> Expanded total % of otolith recoveries in supplemented stock's watershed(s) = 93% (does not include Big Beef stock recoveries since Big Beef Creek was not sampled).

**Table 11.** Actual (top table) and expanded (bottom table) numbers of adipose-clipped summer chum salmon adults recovered in Hood Canal and eastern Strait of Juan de Fuca streams, **2001**. Adipose-clipped fry are released from Quilcene National Fish Hatchery as a part of a supplementation program for the Big/Little Quilcene summer chum stock. The actual numbers sampled were expanded based on the percentage of the total spawner escapement sampled for adipose clips, and an adjustment for adipose clipping efficiency rates at QNFH. The numbers in gray shading represent adults recovered in the Quilcene stock's watersheds (i.e., either Big or Little Quilcene rivers); unshaded numbers are adults recovered in other streams.

Actual numbers sampled, 2001 - AD-clips						Total fish sampled for AD-clips	Total escapement	% escapement sampled for AD-clips	% unmarked + % same-stock supplementation
Unmarked		Big Quilcene (QNFH) AD-clips							
Ages marked (2001 return)		2	3	4	Total				
QNFH ad-clip efficiency by brood		93%	97%	92%					
Recovery location	WRIA								
Little Anderson Cr.	15.0377	10				10	10	100%	100%
Big Beef Cr.	15.0389	894				894	894	100%	100%
Dewatto R.	15.0420	3				3	32	9%	100%
Stavis Cr.	15.0404	1				1	1	100%	100%
Union R.	15.0503	1,491				1,491	1,491	100%	100%
Lilliwaup Cr.	16.0230	n/a	n/a	n/a	n/a	n/a	92	n/a	n/a
Hamma Hamma R.	16.0251	n/a	n/a	n/a	n/a	n/a	1,227	n/a	n/a
Duckabush R.	16.0351	105	16	24	40	145	942	15%	72%
Dosewallips R.	16.0442	104	12	14	26	130	990	13%	80%
Big Quilcene R.	17.0012	341	133	175	308	649	6,185 <sup>1</sup>	10%	100%
Little Quilcene R.	17.0076	61	16		16	77	199	39%	100% <sup>2</sup>
Chimacum Cr.	17.0203	128				128	903	14%	100%
Snow Cr.	17.0219	53				53	154	34%	100%
Salmon Cr.	17.0245	2,567				2,567	2,638	97%	100%
Jimmycomelately Cr.	17.0285	271				271	284 <sup>3</sup>	95%	100%
<b>Total AD marks sampled</b>		5,758	177	213	390	6,419	16,042	40%	99%

Expanded numbers, 2001- AD-clips						Total fish sampled for AD-clips	Total escapement	% escapement sampled for AD-clips	% unmarked + % same-stock supplementation	% AD-clip (adjusted)
Unmarked		Big Quilcene (QNFH) AD-clips								
Ages marked (2001 return)		2	3	4	Total					
Recovery location	WRIA									
Little Anderson Cr.	15.0377	10				10	10	100%	100%	
Big Beef Cr.	15.0389	894				894	894	100%	100%	
Dewatto R.	15.0420	32				3	32	9%	100%	
Stavis Cr.	15.0404	1				1	1	100%	100%	
Union R.	15.0503	1,491				1,491	1,491	100%	100%	
Lilliwaup Cr.	16.0230	n/a	n/a	n/a	n/a	n/a	92	n/a	n/a	n/a
Hamma Hamma R.	16.0251	n/a	n/a	n/a	n/a	n/a	1,227	n/a	n/a	n/a
Duckabush R.	16.0351	665	107	170	277	145	942	15%	71%	29%
Dosewallips R.	16.0442	780	94	116	210	130	990	13%	79%	21%
Big Quilcene R.	17.0012	3,065	1,305	1,815	3,120	649	6,185 <sup>1</sup>	10%	100%	50%
Little Quilcene R.	17.0076	156	43	0	43	77	199	39%	100% <sup>2</sup>	22%
Chimacum Cr.	17.0203	903				128	903	14%	100%	
Snow Cr.	17.0219	154				53	154	34%	100%	
Salmon Cr.	17.0245	2,638				2,567	2,638	97%	100%	
Jimmycomelately Cr.	17.0285	284				271	284 <sup>3</sup>	95%	100%	
<b>Expanded total marks</b>		11,073	1,549	2,101	3,650	6,419	16,042	40%	97%	23%
<b>% of recoveries in Quilcene watersheds</b>			87%	86%	87%					

<sup>1</sup> Includes 11 adults which died during broodstock collection. <sup>2</sup> Does not include otolith recoveries. See Table 12 for otolith recovery data and text for explanation of total recoveries of both types. <sup>3</sup> Includes 24 adults which died prior to spawning.

**Table 12.** Actual (top table) and expanded (bottom table) numbers of otolith-marked summer chum salmon adults recovered in Hood Canal and eastern Strait of Juan de Fuca streams, **2001**. Otolith-marked fry are released from supplementation programs for several summer chum stocks. The actual numbers sampled were expanded based on the percentage of the total spawner escapement sampled for otolith marks. The numbers in gray shading represent adults recovered in the supplemented stock's watershed(s); unshaded numbers are adults recovered in other streams.

Actual numbers sampled, 2001 - otoliths		Supplementation program						Total otoliths readable	Total escapement	% unmarked + same-stock supplementation	
		Unmarked	Big Beef Cr	Lilliwaup Cr	Hamma Hamma	Chimacum	Salmon Cr				Jimmycomelately
<b>Ages marked (2001 return)</b>			2-3	2-4	2-4	2	2-6	2			
<b>Recovery location WRIA</b>											
Little Anderson	15.0377	0	4						4	10	0%
Big Beef Cr	15.0389	30	142				1		173	894	99%
Lilliwaup Cr	16.0230	32	14	20			4	1	71	92	73%
Hamma Hamma	16.0251	95	4				2		101	1,227	94%
Little Quilcene	17.0076	66					6		72	156 <sup>1</sup>	92%
Chimacum Cr	17.0203	87 <sup>2</sup>					9		96	903	91%
Snow Cr	17.0219	16					34		50	154	100%
Salmon Cr	17.0245	120					151		271	2,638	100%
Jimmycomelately Cr	17.0285	113		1			3		117	284 <sup>3</sup>	97%
<b>Total otoliths read</b>		529	164	21	0	0	210	1	955		
Expanded numbers, 2001 - otoliths		Supplementation program						% escapement sampled for otoliths	Total escapement	% unmarked + same-stock supplementation	
		Unmarked	Big Beef Cr	Lilliwaup Cr	Hamma Hamma	Chimacum	Salmon Cr				Jimmycomelately
<b>Ages marked (2001 return)</b>			2-3	2-4	2-4	2	2-6	2			
<b>Recovery location WRIA</b>											
Little Anderson	15.0377	0	10						40%	10	0%
Big Beef Cr	15.0389	155	734				5		19%	894	99%
Lilliwaup Cr	16.0230	41	18	26			5	1	77%	92	73%
Hamma Hamma	16.0251	1,154	49				24		8%	1,227	94%
Little Quilcene	17.0076	143					13		45%	156 <sup>1</sup>	92%
Chimacum Cr	17.0203	818 <sup>2</sup>					85		10%	903	91%
Snow Cr	17.0219	49					105		32%	154	100%
Salmon Cr	17.0245	1,168					1,470		10%	2,638	100%
Jimmycomelately Cr	17.0285	274		2			7		41%	284 <sup>3</sup>	96%
<b>Expanded total</b>		3,802	811	28	0	0	1,714	1	15%	6,358	
% of recoveries in supplemented stock's watershed(s) <sup>4</sup>			91%	91%	--	--	92%	0%			

<sup>1</sup> Includes only adults in escapement without AD-clip. See Table 11 for AD-clip recovery data and text for explanation of total recoveries of both types. <sup>2</sup> Fish from Chimacum Creek reintroduction program were unmarked until 1999 brood. Unmarked fish recovered in 2001 were likely Chimacum reintroduction origin. <sup>3</sup> Includes 24 adults which died prior to spawning. <sup>4</sup> Expanded total % otolith marks recovered in supplemented stock's watershed(s) = 91%.

**Table 13.** Actual (top table) and expanded (bottom table) numbers of adipose-clipped summer chum salmon adults recovered in Hood Canal and eastern Strait of Juan de Fuca streams, **2002**. Adipose-clipped fry are released from Quilcene National Fish Hatchery as a part of a supplementation program for the Big/Little Quilcene summer chum stock. The actual numbers sampled were expanded based on the percentage of the total spawner escapement sampled for adipose clips, and an adjustment for adipose clipping efficiency rates at QNFH. The numbers in gray shading represent adults recovered in the Quilcene stock's watershed (s) (i.e., either Big or Little Quilcene rivers); unshaded numbers are adults recovered in other streams.

Actual numbers sampled, 2002 - AD-clips							Total fish sampled for AD-clips	Total escapement	% escapement sampled for AD-clips	% unmarked + % same-stock supplementation	
		Unmarked	Big Quilcene (QNFH) AD-clips								
Ages marked (2002 return)			2	3	4	5	Total				
QNFH ad-clip efficiency by brood			95%	93%	97%	92%					
Recovery location	WRIA										
Big Beef Cr.	15.0389	742						742	742	100%	100%
Dewatto R.	15.0420	2						2	10	20%	100%
Union R.	15.0503	872						872	872	100%	100%
Lilliwaup Cr.	16.0230	143		1			1	144	858	17%	99% <sup>1</sup>
Hamma Hamma R.	16.0251	179		4	4		8	187	2,328	8%	96% <sup>1</sup>
Duckabush R.	16.0351	88		5	13	1	19	107	530	20%	82% <sup>1</sup>
Dosewallips R.	16.0442	181		6	18		24	205	1,627	13%	88% <sup>1</sup>
Big Quilcene R.	17.0012	204		101	38	2	141	345	4,022 <sup>2</sup>	9%	100%
Little Quilcene R.	17.0076	98		6	11	1	18	116	470	25%	100%
Chimacum Cr.	17.0203	362						362	864	42%	100%
Snow Cr.	17.0219	380						380	532	71%	100%
Salmon Cr.	17.0245	5,326						5,326	5,517	97%	100%
Jimmycomelately Cr.	17.0285	52						52	57 <sup>3</sup>	91%	100%
<b>Total AD marks sampled</b>		8,629	0	124	84	4	211	8,840	18,429	48%	99%

Expanded numbers, 2002 - AD-clips							Total fish sampled for AD-clips	Total escapement	% escapement sampled for AD-clips	% unmarked + % same-stock supplement.	% AD-clip
		Unmarked	Big Quilcene (QNFH) AD-clips								
Ages marked (2002 return)			2	3	4	5	Total				
Recovery location	WRIA										
Big Beef Cr.	15.0389	742						742	742	100%	100%
Dewatto R.	15.0420	10						2	10	20%	100%
Union R.	15.0503	872						872	872	100%	100%
Lilliwaup Cr.	16.0230	852		6	0	0	6	144	858	17%	99% <sup>1</sup> 1%
Hamma Hamma R.	16.0251	2,223		54	51	0	105	187	2,328	8%	95% <sup>1</sup> 5%
Duckabush R.	16.0351	432		27	66	5	98	107	530	20%	82% <sup>1</sup> 18%
Dosewallips R.	16.0442	1,429		51	147	0	198	205	1,627	13%	88% <sup>1</sup> 12%
Big Quilcene R.	17.0012	2,272		1,269	456	25	1,750	345	4,022 <sup>2</sup>	9%	100% 44%
Little Quilcene R.	17.0076	394		26	46	4	76	116	470	25%	100% 16%
Chimacum Cr.	17.0203	864						362	864	42%	100%
Snow Cr.	17.0219	532						380	532	71%	100%
Salmon Cr.	17.0245	5,517						5,326	5,517	97%	100%
Jimmycomelately Cr.	17.0285	57						52	57 <sup>3</sup>	91%	100%
<b>Expanded total AD marks</b>		16,196		1,433	766	35	2,233	8,840	18,429	48%	98% 12%
% of recoveries in Quilcene watersheds				90%	66%	85%	82%				

<sup>1</sup> Does not include otolith-marked recoveries. See Table 14 for otolith recovery data and text for explanation of total recoveries of both types.  
<sup>2</sup> Includes 5 adults which died during broodstock collection. <sup>3</sup> Includes 15 adults which died prior to spawning.

**Table 14.** Actual (top table) and expanded (bottom table) numbers of otolith-marked summer chum salmon adults recovered in Hood Canal and eastern Strait of Juan de Fuca streams, 2002. Otolith-marked fry are released from supplementation programs for several summer chum stocks. The actual numbers sampled were expanded based on the percentage of the total spawner escapement sampled for otolith marks. The numbers in gray shading represent adults recovered in the natal stream; unshaded numbers are adults recovered in other streams.

Actual numbers sampled, 2002 - otoliths		Supplementation program						Total otoliths readable	Total escapement (non-AD clip only)	% unmarked + same-stock supplementation	
		Unmarked	Big Beef Cr	Lilliwaup Cr	Hamma Hamma	Chimacum	Salmon Cr				Jimmycomelately
<b>Ages marked (2002 return)</b>			2-4	2-5	2-5	2-3	2-5	2-3			
<b>Recovery location</b>	<b>WRIA</b>										
Big Beef Cr	15.0389	4	194		1				199	742	99%
Little Lilliwaup Cr.	16.0228	0		2					2	18	0%
Lilliwaup Cr	16.0230	6	17	110	5				138	852 <sup>1</sup>	84% <sup>1</sup>
Hamma Hamma R	16.0251	84	6	3	87				180	2,223 <sup>1</sup>	95% <sup>1</sup>
Duckabush R	16.0351	66		2	12				80	432 <sup>1</sup>	83% <sup>1</sup>
Dosewallips R	16.0442	110	2		7			1	120	1,429 <sup>1</sup>	92% <sup>1</sup>
Little Quilcene R	17.0076	69							69	393 <sup>1</sup>	100% <sup>1</sup>
Chimacum Cr	17.0203	130 <sup>2</sup>	1			10	37		178	864	79%
Snow Cr	17.0219	51					29		80	532	100%
Salmon Cr	17.0245	281				1	134	1	417	5,517	100%
Jimmycomelately Cr	17.0285	2						48	50	57 <sup>3</sup>	100%
<b>Total otoliths read</b>		799	220	117	113	11	200	50	1,513		

Expanded numbers, 2002 - otoliths		Otolith mark stock						% non-AD clip escapement sampled for	Total escapement (non-AD clip only)	% unmarked + same-stock supplementation	
		Unmarked	Big Beef Cr	Lilliwaup Cr	Hamma Hamma	Chimacum	Salmon Cr				Jimmycomelately
<b>Ages marked (2002 return)</b>			2-4	2-5	2-5	2-3	2-5	2-3			
<b>Recovery location</b>	<b>WRIA</b>										
Big Beef Cr	15.0389	15	723		4				27%	742	99%
Little Lilliwaup Cr.	16.0228	0		18					11%	18	0%
Lilliwaup Cr	16.0230	37	105	679	31				16%	852 <sup>1</sup>	84% <sup>1</sup>
Hamma Hamma R	16.0251	1,037	74	37	1,074				8%	2,223 <sup>1</sup>	95% <sup>1</sup>
Duckabush R	16.0351	356		11	65				19%	432 <sup>1</sup>	82% <sup>1</sup>
Dosewallips R	16.0442	1,310	24		83			12	8%	1,429 <sup>1</sup>	92% <sup>1</sup>
Little Quilcene R	17.0076	393							18%	393 <sup>1</sup>	100% <sup>1</sup>
Chimacum Cr	17.0203	631 <sup>2</sup>	5			49	180		21%	864	79%
Snow Cr	17.0219	339					193		15%	532	100%
Salmon Cr	17.0245	3,718				13	1,773	13	8%	5,517	100%
Jimmycomelately Cr	17.0285	2						55	88%	57 <sup>3</sup>	100%
<b>Expanded total</b>		7,838	931	745	1,257	62	2,146	80	12%	13,059	
% of recoveries in watershed(s) of supplemented stock <sup>4</sup>			78%	91%	85%	79%	92%	69%			

<sup>1</sup> Does not include AD-clipped recoveries. See Table 13 for AD-clip data, and text for explanation of total recoveries of both types. <sup>2</sup> Fish from Chimacum reintroduction project were not marked until 1999 brood. Age 3 unmarked fish recovered in 2002 are natural origin recruits; unmarked age 4+ fish are from the reintroduction program. <sup>3</sup> Includes 15 adults which died prior to spawning. <sup>4</sup> Expanded total % otolith marks recoveries in watershed(s) of supplemented stock = 87%.

In 2000, summer chum adults sampled from all streams were examined for adipose-clips to determine the number of adults returning from fry released by the BY 1997 Big Quilcene supplementation program. Two of four age 3 summer chum adults sampled in the Big Quilcene River and 27 of 44 age 3 adults sampled at QNFH were adipose-fin-clipped. In addition, adipose-fin-clipped adults were sampled in Little Quilcene River, Dosewallips River, Duckabush River, and Hamma Hamma River. The recovery of very small numbers of marked fish (3 or fewer per stream) indicates that some level of straying of Big Quilcene River supplementation program adults has occurred into other Hood Canal streams. These adipose clip results for the year 2000 are reported in WDFW and PNPTT (2001).

In 2000, a total of 331 readable otoliths were collected from summer chum adults in seven streams and the percentage of the total escapement sampled for otoliths in the streams ranged from 7% to 96% (22% of total escapement for all streams sampled). The percentage of adult recoveries in a watershed which were either unmarked or were marked as supplementation fish from the same watershed ranged from 66% to 100% in the streams. Of otolith-marked adults recovered from the Salmon Creek supplementation program during 2000, an estimated 93% returned to Snow Creek or Salmon Creek (the same stock occurs in both streams), and some were recovered in Chimacum Creek and the Little Quilcene River. Two otolith-marked adults were recovered in Hamma Hamma River during 2000 and both were from the Hamma Hamma supplementation program (Table 10).

In 2001, a total of 6,419 summer chum adults were examined for adipose marks in thirteen streams and the percentage of the total escapement examined for AD-clips ranged from 9% to 100% in the streams. In nine of the thirteen streams sampled, no AD-clipped summer chum adults were observed. AD-clipped adults comprised 50% of the adults examined in the Big Quilcene River and 21% of the adults examined in the Little Quilcene River (the same stock occurs in both streams); the stream of origin for the AD-clipped fish was the Big Quilcene River. In the Dosewallips and Duckabush rivers, AD-clipped adults comprised 21% and 29% of the adults examined, respectively. AD-clipped adults were observed in the Hamma Hamma River and Lilliwaup Creek (pers. comm. R. Endicott, LLTK), but the numbers of AD-clipped adults and the total number of adults sampled was not recorded. In 2001, an expanded estimate of 87% of AD-clip recoveries occurred in the Big and Little Quilcene rivers, the streams of origin for the Quilcene stock (Table 11).

In 2001, a total of 955 readable otoliths were collected from summer chum adults in nine streams and the percentage of the total escapement sampled for otoliths in the streams ranged from 8% to 77% (15% of total escapement for streams sampled). The percentages of adult returns in a watershed which were either unmarked or were marked as supplementation fish from the same watershed ranged from 73% to 100% (97% across all watersheds). For the supplementation and reintroduction programs, from 0% (single 2-year old recovery from Jimmycomelately program) to 92% of otolith recoveries occurred in the watershed(s) of each supplemented stock; 91% for all programs combined (expanded estimates, Table 12).

In 2001, AD-clipped summer chum were observed in the Little Quilcene River and adults without AD-clips were also examined for otolith marks, providing better total estimates of adults that were marked and unmarked. Total escapement was 199 fish in the Little Quilcene of which an estimated 43 adults were AD-clipped (Table 11) and an estimated 13 adults were otolith-

marked (Table 12), so 28% (56 of 199) of Little Quilcene River summer chum were either AD-clipped or otolith-marked; the remaining 72% were unmarked and presumed to be natural origin recruits.

In 2002, a total of 8,840 summer chum adults were examined for AD-clips in thirteen streams and the percentage of the total escapement examined for AD-clips ranged from 8% to 100% in the streams. In seven of the fifteen streams sampled, no AD-clipped summer chum adults were observed. AD-clipped adults originating from the Quilcene supplementation program comprised 44% of the adults examined in the Big Quilcene River and 16% of the adults examined in the Little Quilcene River. In the Dosewallips, Duckabush, Hamma Hamma, and Lilliwaup rivers, AD-clipped adults comprised 12%, 18%, 5%, and 1% of the adults examined, respectively. In 2002, an expanded total of 82% of AD-clip recoveries occurred in the Big and Little Quilcene rivers, which are the streams of origin for the Quilcene stock (Table 13).

In 2002, a total of 1,513 readable otoliths were collected from summer chum adults in eleven streams and the percentage of the non-AD-clipped total escapement sampled for otoliths in the streams ranged from 8% to 88% (12% of total escapement for watersheds sampled). The percentage of adult recoveries in a watershed which were either unmarked or were marked as supplementation fish from the same watershed ranged from 79% to 100% (95% for all streams combined). For the supplementation and reintroduction programs, the total percentage of otolith recoveries that occurred in the natal stream (i.e., the stream of origin for the supplementation programs) ranged from 78% to 92%; and was 87% for all programs combined. No summer chum supplementation programs occur on the Dosewallips and Duckabush rivers and otolith samples were collected there for the first time in 2002. Otolith-marked adults from the Lilliwaup and Hamma Hamma supplementation programs were recovered on the Duckabush River; unmarked adults comprised 82% of the total escapement. Otolith-marked adults from the Big Beef Creek and Hamma Hamma supplementation programs were recovered on the Dosewallips River; unmarked adults comprised 92% of the total escapement (Table 14).

In 2002, AD-clipped summer chum were observed in the Little Quilcene, Dosewallips, Duckabush, Hamma Hamma, and Lilliwaup rivers and adults without AD-clips were also examined for otolith marks in these streams, providing better total estimates of adults which were marked and unmarked. Total escapement was 470 fish in the Little Quilcene, of which an estimated 76 adults were AD-clipped (Table 13) and no adults were otolith-marked (Table 14). Therefore, 16% (76 of 470) of Little Quilcene River summer chum were either AD-clipped or otolith-marked; the remaining 84% were unmarked and presumed to be natural origin recruits. For the Dosewallips River, 19% (estimated 317 of 1,627) of summer chum adults were either AD-clipped or otolith-marked (Tables 13 and 14); the remaining 81% were unmarked and presumed to be natural origin recruits. For the Duckabush River, 33% (estimated 174 of 530) of summer chum adults were either AD-clipped or otolith-marked; the remaining 67% were unmarked and presumed to be natural origin recruits. For the Hamma Hamma River, 55% (estimated 1,290 of 2,328) of summer chum adults were either AD-clipped or otolith-marked (with an estimated 1,074 of the otolith-marked adults originating from the Hamma Hamma supplementation program); the remaining 45% were unmarked and presumed to be natural origin recruits. Finally, for Lilliwaup Creek, 96% (estimated 821 of 858) of summer chum adults were either AD-clipped or otolith-marked (with an estimated 679 of the otolith-marked adults originating from the Lilliwaup supplementation program); the remaining 4% were unmarked and presumed to be natural origin recruits.

Most supplementation program adults have been recovered in their stock's own watersheds, however, some of the adults have also been recovered in other streams during 2000, 2001, and 2002. The natural exchange (or stray) rate for Hood Canal and eastern Strait of Juan de Fuca summer chum populations is not known. The Co-managers will continue to monitor recoveries of supplementation program adults and will assess potential impacts once more information is available.

Further descriptions of mark recoveries are provided in the individual reports for each supplementation program (see Section 4, Artificial Production). In addition, an examination of otoliths from 194 chum salmon sampled in the 2002 Area 7 reef net fishery is discussed above in Section 2, Stock Assessment - Genetic Stock Identification.

The number of otolith marks observed from adult summer chum salmon sampled in eastern Strait of Juan de Fuca and Hood Canal streams are presented for age 2, 3, 4, and 5 fish in Appendix Tables 3, 4, and 5 for the 2000, 2001, and 2002 return years, respectively.

## ***PRODUCTIVITY***

Productivity is a measurement of the number of adult chum salmon that are ultimately produced by each year's spawning escapement. Since the summer chum salmon from a given year's spawner population (brood year) return as 2-, 3-, 4-, and 5-year old fish, it is necessary to have reliable age composition data for each annual return. The total returns for each brood year are divided by the number of parent spawners to arrive at the brood year production rate, typically expressed as recruits per spawner.

There is currently insufficient age composition information for estimating the productivity of summer chum salmon, either on an individual stock or region-wide basis. Age data are now being collected for each stock by sampling and reading the scales of spawned-out chum collected on the spawning grounds and scales of adults used as brood stock in supplementation programs (Tables 7 and 8). Examining otoliths recovered from spawned adults and checking for presence/absence of adipose fins provides a way to separate the number of supplementation (hatchery) fish from the number of naturally spawning fish; and these mark data are also being summarized by age (Appendix Tables 3, 4, and 5). Over time as sufficient data is collected, the data can be used to develop estimates of age-specific returns of natural origin recruits and lead to productivity estimates for each stock. The Co-managers are committed to collecting this information, but may need additional funding to assemble an adequate age data base.

## **EXTINCTION RISK UPDATE**

The extinction risk faced by individual summer chum stocks is assessed periodically based on the methodology proposed by Allendorf et al. (1997), and discussed in sect. 1.7.4 of SCSCI. The Allendorf et al. (1997) methodology consists of a set of procedures for rating extinction risk and for providing an estimation of the possible consequences of extinction for Pacific salmon stocks. The methods for estimating extinction risk use either population viability analysis (PVA) or a set of surrogate measures that include current population size parameters and population trends.

The methods used to assess extinction risk result in the ranking of individual stocks into one of four categories; very high, high, moderate, and special concern (see SCSCI Table 1.11). For the purposes of this assessment, a “low” category was added for defining stocks that did not fit any of the above categories and are not at risk of extinction. Hood Canal and Strait of Juan de Fuca summer chum stocks were first rated for extinction risk in the SCSCI (see SCSCI Table 1.12). The original risk assessment was subsequently up-dated in the SCSCI 2000 Annual Report (WDFW and PNPTT 2001), based on population sizes during the 1997-2000 return years. Table 15 below presents the current extinction risk assessments for summer chum stocks based on the 1999 through 2002 return year escapements (Appendix Tables 1 and 2). Short discussions for each stock follow.

### **UNION RIVER**

Estimated escapements to the Union River show no declining trend over the period of record and, in fact, appear to have increased somewhat since the 1970s. Escapements over the last four years have ranged from 159 to 1,491, averaging 817 spawners. This stock has shown a recent increasing escapement trend, and its risk of extinction is now rated as low.

### **LILLIWAUP CREEK**

Estimated escapements to Lilliwaup Creek range from 13 to 858 over the last four years, averaging 246 spawners. The effective population size ( $N_e$ ) equals 77 fish for the 1999-02 return years, and total population size ( $N$ ) is 887 for the same years. Because the population meets two high risk criteria (low population size,  $N_e < 500$  or  $N < 2,500$ ) and is in a chronic depression situation, the risk of extinction is judged to be high.

### **HAMMA HAMMA RIVER**

The annual average estimated Hamma Hamma system escapement over the past four years is 1,010 summer chum, ranging from 229 to 2,328 spawners. The effective population size ( $N_e$ ) equals 727 fish for the 1999-02 return years, and total population size ( $N$ ) is 3,636 for the same years. Because the population exceeds the high risk abundance criterion (population size,  $N_e < 500$  or  $N < 2,500$ ) and is currently increasing relative to the low years from 1987-1993, the risk of extinction is judged to be low.

**Table 15.** Extinction risk assessment for summer chum salmon based on escapements for the 1999 through 2002 return years (method from Allendorf et al. 1997).

Stock	Escapement (mean 99-02)	Effective Population Size ( $N_e$ ) <sup>1</sup>	Total Population Size ( $N$ ) <sup>2</sup>	Recent Population Trend	Risk Rating
Union	817	588	2,939	Increasing	Low
Lilliwaup					
Current status	246	77	887	Chronic depression	High
Pre-project status	22 <sup>3</sup>	16	78	Chronic depression	High
Hamma Hamma					
Current status	1,010	727	3,636	Increasing	Low
Pre-project status	175 <sup>3</sup>	126	630	Increasing	Moderate
Duckabush	507	365	1,825	Increasing	Moderate
Dosewallips	1,057	761	3,805	Increasing	Low
Big/Little Quilcene					
Current status	4,999	3,599	17,996	Stable	Low
Pre-project status	89 <sup>4</sup>	64	320	Precipitous decline	High
Snow/Salmon					
Current status	2,375	1,710	8,550	Increasing	Low
Pre-project status	226 <sup>5</sup>	163	814	Precipitous decline	High
Jimmycomelately	91	66	328	Chronic depression	High
Dungeness	No data	Not available	Not available	Not available	Special concern

<sup>1</sup> Effective population size ( $N_e$ ) = Average escapement x 3.6 (generation length) x 0.2 ( $N_e/N$ ).

<sup>2</sup> Total population size ( $N$ ) = Average escapement x 3.6 (generation length).

<sup>3</sup> Lilliwaup, and Hamma Hamma average escapements for 1997 through 2000 return years.

<sup>4</sup> Big/Little Quilcene average escapement for 1988 through 1991 return years.

<sup>5</sup> Snow/Salmon creeks average escapement for 1989 through 1991 return years (see text).

## DUCKABUSH RIVER

The estimated escapement to the Duckabush River ranges from 92 to 942 summer chum over the last four years, averaging 507 spawners. The effective population size ( $N_e$ ) equals 365 fish for the 1999-02 return years, and total population size ( $N$ ) is 1,825 for the same years. Though escapements have declined substantially since the 1970s, the current escapement levels are higher than the low levels experienced from 1984 through 1990. The recent population size for this stock ( $N_e < 500$  or  $N < 2,500$ ) indicates that the risk of extinction for Duckabush summer chum is moderate.

## DOSEWALLIPS RIVER

The 1999 through 2002 annual average escapement of summer chum salmon was 1,057 spawners, ranging from 47 to 1,260 fish. The effective population size ( $N_e$ ) equals 761 fish for the 1999-02 return years, and total population size ( $N$ ) is 3,805 for the same years. Escapements have increased substantially over the lows experienced in the 1980s and the recent population size for this stock exceeds the risk abundance criterion ( $N_e < 500$  or  $N < 2,500$ ), indicating that the current risk of extinction for Dosewallips summer chum is low.

## **BIG/LITTLE QUILCENE RIVERS**

Escapement estimates averaged 4,999 summer chum spawners (range of 3,237 to 6,373) for the Big/Little Quilcene summer chum stock for the 1999 through 2002 return years. The combined (including broodstock removals) total effective population size ( $N_e$ ) equals 3,599 fish for the 1999-02 return years, and the total population size ( $N$ ) is 17,996 for the same years. These recent returns likely were affected by the existing supplementation project begun in 1992. Based on a stable escapement trend and the large recent escapements, the current extinction risk for this stock is low.

## **SNOW/SALMON CREEKS**

From 1999 through 2002, escapement estimates averaged 2,375 spawners (range of 528 to 6,049) for the Snow/Salmon stock. The effective population size ( $N_e$ ) equals 1,710 fish for the 1999-02 return years, and total population size ( $N$ ) is 8,550 for the same years. The recent return estimates were affected by returns to the existing supplementation project begun on Salmon Creek in 1992. Since the stock (with two streams combined) has experienced increasing overall escapements in recent years and average escapement exceeds the population size risk criteria, the current risk of extinction is judged to be low.

## **JIMMYCOMELATELY CREEK**

Escapements for Jimmycomelately Creek for the past four years annually averaged 91 spawners (range of 7 to 260). The effective population size ( $N_e$ ) equals 66 fish for the 1999-02 return years, and total population size ( $N$ ) is 328 for the same years. Because of the precipitous decline of this stock and population sizes meeting the high risk criteria ( $N_e < 500$  or  $N < 2,500$ ), the risk of extinction is judged to be high.

## **DUNGENESS RIVER**

Summer chum spawner information comes from observations made in the course of collecting data on chinook and pink salmon as part of ongoing stock assessment and recovery efforts for these two species. More detailed information is needed before extinction risk can be evaluated and, in the interim, the Dungeness River stock risk is rated to be of special concern.

## ***ADDRESSING STOCK ASSESSMENT INFORMATION NEEDS***

As noted in section 3.5.12 of the SCSCI, success of the implementation plan is dependent on application of the best current data and data analysis to the management of the summer chum salmon resource. Several stock assessment information needs identified in SCSCI section 3.5.12 have been addressed by the Co-managers during 2001 and 2002, including the following.

- The frequency of escapement surveys continues to be excellent with surveys conducted on a weekly basis. This survey coverage provides very good escapement estimates.
- Age composition information is being collected for each management unit from spawned out chum on the spawning grounds and/or from broodstock used in the supplementation programs. Over time as sufficient data are collected, the data can be used to develop estimates of age-specific returns and lead to productivity estimates for each management unit.
- Contribution of supplementation-origin adults to natural spawning escapement and recovery of program adults in streams other than the streams of release are being determined through marking programs and sampling for marks on the spawning grounds of more streams than in the past. However, additional funding is needed to expand escapement surveys for mark sampling and to pay for otolith analysis.



## **3 - HARVEST MANAGEMENT**

The following section summarizes the harvest management actions, and results of those actions, relative to summer chum salmon in the years 2001 and 2002. These years were the second and third year in which the Base Conservation Regime (BCR) was implemented and the results can generally be described as very good. Tables 16-18 provide a final overview for the years 2000 and 2001 and a preliminary overview for 2002, including the preseason estimates which triggered the various management responses, as well as the post-season estimates of results. As indicated, the information for 2002 is preliminary and subject to revision when commercial catch data are verified and recreational catch data are included. Tables 19-21 show the estimated annual harvest of summer chum salmon, by management unit and fishery. Table 22 provides an overview of exploitation rates, relative to the BCR targets, for 2000 through 2002.

<b>Table 16.</b> Post-season assessment of forecasts, recruitment, and escapement by summer chum salmon harvest management unit in the year 2000.					
<b>Management Category</b>	<b>Sequim</b>	<b>Discovery</b>	<b>Quilcene</b>	<b>Mainstem Hood Canal</b>	<b>SE Hood Canal</b>
Preseason Recruit Forecast	82	710	3,945	2,601	442
Postseason Recruit Estimate	55	879	6,704	2,035	757
Forecast Error	49.1%	-19.2%	-41.2%	27.8%	-41.6%
Expected Escapements <sup>1</sup>	50	802	4,176	1,813	662
Est. Escapement	55	876	5,898	2,005	746
BCR Escapement Target Exceedance	9.6%	9.3%	41.2%	10.6%	12.8%
Estimated Exploitation Rate	0.0%	0.3%	12.0%	1.5%	1.5%
<sup>1</sup> Expected escapements are generally those that would result from application of BCR target exploitation rates ( Table 3.35 of SCSCI). In the case of Quilcene, it was assumed that up to 50% of the entry after mid-September could have been considered "harvestable".					

**Table 17.** Post-season assessment of forecasts, recruitment, and escapement by summer chum salmon harvest management unit in the year 2001.

Management Category	Sequim	Discovery	Quilcene	Mainstem Hood Canal	SE Hood Canal
Preseason Recruit Forecast	56	885	5,396	1,057	418
Postseason Recruit Estimate	262	2,811	7,595	4,248	1,516
Forecast Error	-78.6%	-68.5%	-29.0%	-75.1%	-72.4%
Expected Escapements <sup>1</sup>	239	2,564	4,399	3,785	1,325
Est. Escapement	260	2,792	6,373	4,177	1,491
BCR Escapement Target Exceedance	8.8%	8.9%	44.9%	10.4%	12.5%
Estimated Exploitation Rate	0.8%	0.7%	16.1%	1.7%	1.6%

<sup>1</sup> Expected escapements are generally those that would result from application of BCR target exploitation rates (Table 3.35 of SCSCI). In the case of Quilcene, it was assumed that up to 50% of the entry after mid-September could have been considered “harvestable”.

**Table 18.** Post-season assessment of forecasts, recruitment, and escapement by summer chum salmon harvest management unit in the year 2002.

Management Category	Sequim	Discovery	Chimacum	Quilcene	Mainstem Hood Canal	SE Hood Canal
Preseason Recruit Forecast	112	1,356	333	5,230	1,941	675
Postseason Recruit Estimate <sup>1</sup>	42	6,070	867	<b>6,044</b>	<b>6,218</b>	890
Forecast Error	166.7%	-77.7%	-61.6%	<b>-13.5%</b>	<b>-68.8%</b>	-24.2%
Expected Escapements <sup>2</sup>	38	5,536	791	4,011	5,540	778
Est. Escapement	42	6,049	864	4,487	6,095	872
BCR Escapement Target Exceedance	9.6%	9.3%	9.3%	11.9%	10.0%	12.1%
Estimated Exploitation Rate <sup>1</sup>	0.0%	0.3%	0.3%	<b>25.8%</b>	<b>2.0%</b>	2.0%

<sup>1</sup> Post season recruit estimates are preliminary and will be revised upwards when recreational harvest estimates are added. Rate estimates are rounded to nearest 1/10th of 1%.

<sup>2</sup> Expected escapements are generally those that would result from application of BCR target exploitation rates (Table 3.35 of SCSCI). In the case of Quilcene, it was assumed that up to 50% of the entry after mid-September could have been considered “harvestable”.

<b>Table 19.</b> Summer chum salmon harvest, in 2000, by management unit and fishery.					
<b>Fishery</b>	<b>Sequim</b>	<b>Discovery</b>	<b>Quilcene</b>	<b>Mainstem Hood Canal</b>	<b>SE Hood Canal</b>
Canada	0	2	18	5	2
U.S. Mixed	0	1	10	3	1
Terminal	0	0	73	22	8
Extreme Terminal	0	0	707	0	0

<b>Table 20.</b> Summer chum salmon harvest, in 2001, by management unit and fishery.					
<b>Fishery</b>	<b>Sequim</b>	<b>Discovery</b>	<b>Quilcene</b>	<b>Mainstem Hood Canal</b>	<b>SE Hood Canal</b>
Canada	1	10	28	16	5
U.S. Mixed	1	9	29	16	6
Terminal	0	0	70	39	14
Extreme Terminal	0	0	1,095	0	0

<b>Table 21.</b> Summer chum salmon harvest, in 2002, by management unit and fishery. <sup>1</sup>						
<b>Fishery</b>	<b>Sequim</b>	<b>Discovery</b>	<b>Chimacum</b>	<b>Quilcene</b>	<b>Mainstem Hood Canal</b>	<b>SE Hood Canal</b>
Canada	0	12	2	13	12	2
U.S. Mixed	0	9	1	9	10	2
Terminal	0	0	0	98	101	14
Extreme Terminal	0	0	0	<b>1,437</b>	<b>0</b>	0

<sup>1</sup> Post season harvest estimates are preliminary and will be revised upwards when recreational harvest estimates are added.

<b>Table 22.</b> Post season assessment of exploitation rates for 2000 through 2002, compared to Base Conservation Regime (BCR) target levels.				
<b>Management Unit</b>	<b>Exploitation Rates</b>			
	<b>BCR Target</b>	<b>2000 Est.</b>	<b>2001 Est.</b>	<b>2002 Est. <sup>1</sup></b>
Sequim	8.8%	0.0%	0.8%	0.0%
Discovery	8.8%	0.3%	0.7%	0.3%
Chimacum	na	na	na	0.3%
Quilcene	15.2%	12.0%	16.1%	25.8%
Mainstem HC	10.9%	1.5%	1.7%	2.0%
Southeast HC	12.6%	1.5%	1.6%	2.0%

<sup>1</sup> Based on preliminary harvest data; recreational catch not included.

## ***PRESEASON ESTIMATES AND PLANNING***

Both preseason forecasts, for 2001 and 2002, indicated that the Sequim and Mainstem Hood Canal management units' (MU) abundance would fall short of the critical threshold, to varying degrees. The preseason forecasts are presented in the Hood Canal and Strait of Juan de Fuca Framework Management Plans (PNPTC and WDFW; 2001, 2002; and PNPTC, WDFW, Makah Tribe; 2001, 2002). There was no preseason testing for "flags" relative to individual populations within the Mainstem Hood Canal MU, because the entire MU was already predicted to be below its critical threshold.

Preseason planning by the Co-managers, in the PFMC/NOF process, focused on harvest management provisions for U.S. fisheries which were generally adopted in conformity with those found in Tables 3.29 - 3.34 of the SCSCI. Following Co-manager consultation and review of fishery proposals, no additional measures were identified to address units predicted to be below the critical threshold. Provisions not implemented in 2001 and 2002 included the release of chum salmon in Area 4 troll and recreational fisheries, the release of chum salmon in Area 10 recreational fisheries, and release from treaty Indian seines in Areas 7 and 7A. However, there appears to be no indication, given presently available data, that any significant numbers of summer chum salmon were caught in these fisheries. Detailed descriptions of the adopted measures for terminal areas can be found in the Co-managers' joint reports on the 2001 and 2002 seasons, the Management Framework Plan and Salmon Runs' Status reports for Strait of Juan de Fuca (PNPTC, WDFW and Makah Tribe 2001, 2002) and Hood Canal (PNPTC and WDFW 2001, 2002). For pre-terminal fishery plans and agreements, a description can be found in the Summary Fishing Agreements for Treaty and Nontreaty Fisheries in the Ocean, North of Cape Falcon, and in Puget Sound (WDFW and Western Washington Treaty Tribes 2001, 2002).

## ***INSEASON AND POST-SEASON ESTIMATES AND MANAGEMENT ACTIONS***

Estimated exploitation rates for Canadian fisheries were well below the level of BCR, however it should be noted that the estimated mortality in 2001 resulted solely from PSC test fisheries. In 2002, the estimated mortality resulted from PSC test fisheries and two purse seine openings in Canadian Area 20. In U.S. mixed stock areas the exploitation was also well below the BCR level. Finally, in terminal areas, exploitation rates were well below the BCR levels except for the Quilcene MU; however, as with other management units, the expected escapements for the Quilcene MU were exceeded in all three years (Tables 16, 17, and 18).

In 2001, post-season estimates of recruitment were higher than the pre-season forecasts for all MUs, (Table 17). The higher than predicted abundance resulted in the critical threshold being exceeded for all MUs. However, within the Mainstem Hood Canal MU, Lilliwaup abundance was below its critical threshold. In 2002, post-season estimates again were higher than the pre-season forecasts in all cases, except the Sequim MU, where the forecast was influenced by the abundant return of 2001 (Table 18). Since the Mainstem Hood Canal MU exceeded its critical abundance threshold, individual population abundances were also examined, revealing that all populations exceeded their critical abundance threshold except Duckabush. The 2002 post-

season abundance estimates are preliminary and will become higher when recreational harvest estimates become available and are added to the total.

During the 2001 and 2002 seasons, no changes were made from the initially adopted plans. Using provisions of the BCR, an inseason projection of escapement to the Quilcene MU was made each year. The projections indicated that escapement would be significantly above the thresholds provided in the SCSCI for fishery modification. In both years, regulations were somewhat relaxed, permitting the continued use of gillnets by the Treaty Indian fishery. However, gillnet effort was very low, resulting in no additional summer chum exploitation in Area 12A. Provisions were also made for coho harvest in the Quilcene River, immediately below the hatchery, in both years.

With the exception of the Quilcene MU, where separate management provisions apply, escapement rates varied between the MUs, ranging from 98.3% to 99.3% in 2001 and from 98.0% to 100.0% in 2002 (incomplete results). In the Quilcene MU, the escapement rates in 2001 and 2002 were 83.9% and 74.2% respectively. Therefore, fisheries in 2001 and 2002 did not exacerbate conditions for any of the units whose abundance was below the critical threshold.

## ***INFORMATION SOURCES***

Harvest contributions were estimated using the same methods as those used during the preparation of the SCSCI. No additional information became available for use in this task.

Assessment of survival to recruitment, by age was not possible for the preparation of forecasts for return years 2001 and 2002, however, age at return information is being collected and analyzed for this purpose (see Biological Data sub-section above in Stock Assessment section). It is anticipated that sufficient information may have been collected for use prior to the 2004 return year.

Escapement monitoring met or exceeded the requirements of SCSCI. Quality of data used to estimate escapements was judged good in nearly all cases (see Appendix Report 1, below).

Harvest information was based on a number of sources. For Canadian fisheries, catches were reported by Pacific Salmon Commission (PSC) (Christine Tovey - PSC, Leroy Hop Wo - CDFO; personal communication to Nick Lampsakis). For pre-terminal and terminal US fisheries, the Co-managers relied on fish ticket data. For US recreational fisheries, the Co-managers relied on the WDFW catch record card expanded information for the completion of 2000 and 2001 reconstructions. For 2002, this information will be used to update estimates, when it becomes available (expected in the fall of 2003).

## ***MONITORING***

In addition to catch record data, pre-terminal and terminal area commercial catches were sampled at buying stations, as part of a CWT recovery program, and any chum salmon were recorded. In recreational fisheries, sampling was used primarily in Areas 5, 6, 12, 12A, 12B and 12C to estimate encounters.

No summer chum biological data were collected in fisheries, primarily because of the scarcity of catch and the difficulties involved in setting up biological sampling programs for very small numbers of fish.

## ***COMPLIANCE AND ENFORCEMENT***

All parties adopted regulations in accordance with the preseason plan and SCSCI. Compliance by the parties was as specified in the SCSCI. Implementation of enforcement indicated no significant violations, except for two incidents in Area 12A, in 2002, involving the retention of a significant number of summer chum salmon by beach seiners. In order to avoid the possible repetition of such incidents, the fishery was terminated for the remainder of the season.

In the Strait of Juan de Fuca and Hood Canal terminal and extreme terminal areas where summer chum salmon are likely to be present in significant quantities, additional fishery patrol efforts were directed by the treaty Tribes and WDFW. More specifically, areas covered during the months of August and September, included Dungeness Bay, Sequim Bay, Discovery Bay, Quilcene Bay and River, Area 12C and numerous rivers where summer chum salmon would be present.

Tribal patrol officers placed particular emphasis on contacting tribal fishers, to inform them of the need to release all live chum salmon. An effort was also made to inspect catches, where available, during nearshore fishing operations. To monitor the fisheries and protect summer chum returning to spawn, WDFW enforcement personnel conducted emphasis patrols on the coho-directed sport fishery in the Big Quilcene River and routinely patrolled Hood Canal marine waters during the 2001 and 2002 seasons. During 2002, from mid-August through October, officers made 2,233 contacts with anglers (non-tribal and tribal) and wrote 241 citations of which 14 were directly related to summer chum (i.e., closed season, closed area, or summer chum retention violations). The overall assessment was that the fisheries were orderly, the area closure on the lower Big Quilcene River (downstream of Rodgers Street) to protect summer chum worked well, and compliance improved as citations were issued.

During fall 2001, several hundred live summer chum adults were evidently removed from the Big Quilcene River by anglers and released into a gravel trap adjacent to the Big Quilcene River, where they were found dead. To remove this as a potential problem, Jefferson County Department of Public Works complied with a request from WDFW to discontinue excavation of the gravel traps in the future. The gravel traps filled in during winter 2001 and there were no subsequent incidents during fisheries in 2002.

## **4 - ARTIFICIAL PRODUCTION**

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Artificial production (hatchery) techniques may be used to supplement currently depressed wild summer chum populations or to reintroduce summer chum into streams where the original population no longer exists. When properly implemented, supplementation and reintroduction can be powerful tools which, in combination with harvest and habitat management actions, can contribute to the recovery or restoration of naturally-producing populations (Ames and Adicks, in press). As described in section 3.2 of the SCSCI, the intent of supplementation of summer chum in the Hood Canal Region is to reduce the short term extinction risk to summer chum populations and to increase the likelihood of their recovery.

This section of the annual report is organized to provide background information for six ongoing supplementation and two ongoing reintroduction projects, including a brief history, an overview of project monitoring and evaluation, and a perspective on the Hatchery and Genetic Management Plans prepared for each project. Individual reports are also provided for each project which include more detailed information on annual production and monitoring and evaluation, as well as a general program assessment.

### **BACKGROUND**

#### ***HISTORY OF PROJECTS***

Consistent with the SCSCI, supplementation has been applied as a strategy to help recover summer chum populations in Hood Canal and the eastern Strait of Juan de Fuca since 1992. Programs initiated in 1992 include Big Quilcene River, Lilliwaup Creek, and Salmon Creek supplementation projects. Re-introduction of summer chum into Chimacum and Big Beef creeks began in 1996; summer chum adults have returned to these streams since 1999. Supplementation programs were also initiated on Hamma Hamma River in 1997, on Jimmycomelately Creek in 1999, and on Union River in 2000. All of these summer chum recovery programs are on-going. Cooperators participating in the projects with WDFW and the PNPT Tribes include Hood Canal Salmon Enhancement Group (HCSEG), North Olympic Salmon Coalition (NOSC), Wild Olympic Salmon (WOS), Long Live the Kings (LLTK), and the U.S. Fish and Wildlife Service (USFWS). Programs are operated using WDFW and USFWS hatcheries, a private hatchery owned by LLTK, and remote site facilities operated by the cooperators. WDFW oversees operation of the cooperators' programs.

#### ***HATCHERY AND GENETIC MANAGEMENT PLANS***

Hatchery and Genetic Management Plans (HGMPs) have been prepared by WDFW and the U.S. Fish and Wildlife Service (USFWS) and submitted to NMFS for each of the summer chum supplementation and reintroduction programs in the eastern Strait of Juan de Fuca and Hood Canal areas. Each HGMP provides a thorough description of each hatchery operation including the facilities used, methods employed to propagate and release fish, measures of performance, status of ESA-listed stocks that may be affected by the program, anticipated listed fish "take" levels, and descriptions of risk minimization measures applied to safeguard listed fish. Much of the information in the HGMPs was derived from the SCSCI. The HGMPs were approved by

NMFS under Limit 5 of the ESA 4(d) Rule for a 12 year period. A copy of each HGMP is available at NMFS Northwest Region web site at “www.nwr.noaa.gov”.

### ***PROJECT MONITORING AND EVALUATION***

Critical objectives of the SCSCI include the monitoring and evaluation of the effects of supplementation on the natural summer chum populations and of the effectiveness of the programs in the recovery of summer chum (see section 3.2.2.4 of the SCSCI). The basic approach is to collect information that will help determine 1) the degree of success of each project; 2) if a project is unsuccessful, why it was unsuccessful; 3) what measures can be implemented to adjust a program that is not meeting objectives for the project; and 4) when to stop a supplementation project.

Each project is to be fully consistent with the intent and implementation of the monitoring and evaluation component for supplementation programs identified in the SCSCI. The recommendations for monitoring and evaluation in the SCSCI respond to concerns regarding the uncertainty of summer chum supplementation and reintroduction effects by addressing the following four elements:

*Element 1* - The estimated contribution of supplementation/reintroduction program-origin chum to the natural population during the recovery process;

*Element 2* - Changes in the genetic, phenotypic, or ecological characteristics of populations (target and non-target) affected by the supplementation/reintroduction program;

*Element 3* - The need and methods for improvement of supplementation/reintroduction activities in order to meet program objectives, or the need to discontinue a program because of failure to meet objectives; and

*Element 4* - Determination of when supplementation has succeeded and is no longer necessary for recovery by collection and evaluation of information on adult returns.

Monitoring and evaluation were managed for each of the individual projects, consistent with the above four elements as follows:

*Fish marking, mark recovery, and adult returns* - The summer chum salmon juveniles (either embryos or fry) produced by each supplementation program are mass-marked (otolith-marked or fin-clipped) prior to release. Spawning ground surveys are conducted throughout the summer chum escapement period to enumerate spawners and to collect information on fish origin and age composition. Examination of otoliths or fin clip ratios from spawned adults provides a method to estimate the number of supplementation (hatchery) fish versus the number of natural origin (wild) fish and assists in determining the contribution of the supplementation program to the target population.

*Genetic and age sampling* - In order to detect any changes in genetic characteristics of populations, periodic allozyme and/or DNA samples have been collected from summer chum since most supplementation programs were started, for comparison to earlier collections. Analysis of allozyme samples has been completed (Kassler and Shaklee, 2003); see Appendix Report 3. DNA samples are being analyzed to develop a baseline for summer chum (Small and Young 2003); see Appendix Report 4. Scales are also collected to age the adult fish.

*Broodstocking and egg sources* - To fully represent the demographics of donor populations, summer chum broodstock are collected randomly as the fish arrive at temporary fish traps (operated by WDFW or project sponsors) in proportion to the timing, weekly abundance, and duration of the total return. Fish not retained as broodstock are released upstream of trap sites to spawn naturally.

*Hatchery operations* - Records of fish cultural operations are regularly maintained and compiled. Project sponsors in collaboration with WDFW, prepare annual reports that summarize protocols and procedures, temperature unit records by developmental stage, ponding dates, feeding, rearing and release methods, and production and survival data, and that recommend facility or protocol improvements.

*Fish health* - Fish health is monitored by a WDFW or USFWS fish health specialist in accordance with procedures in the Co-managers' disease control policy (NWIFC and WDFW 1998). Summer chum broodstock are sampled for the incidence of viral pathogens, there has been no significant mortality of broodstock or juveniles from unknown causes, and the health of fry from all projects prior to release has been good.

Additional descriptions of monitoring and evaluation activities and/or results are provided below.

## ***INDIVIDUAL PROJECT REPORTS***

Individual project reports are presented for each supplementation and reintroduction project in the Hood Canal and Strait of Juan de Fuca regions. Appendix Report 3.2 of the SCSCI provides descriptions of the Big Quilcene, Lilliwaup, Hamma Hamma, Big Beef Creek, Salmon Creek, and Chimacum Creek programs, including program objectives, broodstock and production data through brood year 1998, and operating procedures and objectives. Information on these projects has since been updated for the years 1999 and 2000, and project descriptions provided for the newer Union River and Jimmycomelately Creek projects in Supplemental Report No. 3 (WDFW and PNPTT 2001). Now, information for all projects is updated for years 2001 and 2002 in the following reports.

## **HOOD CANAL REGION**

### **BIG QUILCENE RIVER**

A supplementation program was started in 1992, in response to the critical condition of the stock and to take advantage of a year expected to be relatively strong in the Hood Canal summer chum return cycle. The program is operated by the USFWS at the Quilcene National Fish Hatchery (QNFH). It is apparent that the Big Quilcene supplementation project has contributed to increased returns observed for this stock (see below). The Quilcene program contributed eggs and fry to support the re-introduction program for summer chum at Big Beef Creek in its early years (from 1996 through 2000).

### **ANNUAL PRODUCTION**

A summary of the production for each brood year of the project is presented in Table 23.

<b>Brood year</b>	<b>Broodstock retained</b>			<b>Natural spawners</b>	<b>Percent removed</b>	<b>Fed fry released</b>	<b>Release size, g</b>	<b>Release dates(s)</b>
	<b>Males</b>	<b>Females</b>	<b>Total</b>					
1992	225	186	411	320	56%	216,441	1.05	4/13/93
1993	19	17	36	97	27%	24,784	1.46	3/30/94
1994	184	178	362	349	51%	343,550	1.06	3/27/95
1995	243	256	499	4,029	11%	441,167	1.06	3/27/96
1996	438	333	771	8,479	8%	612,598	1.34	4/10/97
1997	296	261	557	7,339	7%	340,744	1.62	4/2, 4/15/98
1998	313	231	544	2,244	20%	343,530	1.28	3/8, 3/22, 4/2/99
1999	81	89	170	2,982	5%	181,711	1.03	3/9, 3/24/00
2000	187	195	382	5,126	7%	414,353	1.01	3/5, 3/19/01
2001	134	172	306	5,868	5%	351,709	0.98	3/3, 3/22/02
2002	174	181	355	3,662	9%	272,017	0.79	3/7, 3/24/03

The transfers of summer chum eyed eggs and fry from the Quilcene NFH to Big Beef Creek for brood years 1996 through 2000 are summarized in Table 24.

<b>Brood year</b>	<b>Fry</b>	<b>Eyed eggs</b>
1996	40,000	168,000
1997	0	157,000
1998	0	217,465
1999	0	40,298
2000	0	55,500
2001	0	0
2002	0	0

## MONITORING AND EVALUATION

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

*Fish marking, mark recovery and adult returns* - Beginning with brood year 1997 (3-year olds returning in 2000), the summer chum fry released at Quilcene NFH were adipose-clipped to identify returning adults as hatchery-origin fish. Adult sampling results are described in detail under Mark Recovery in Section 2. Table 25 provides a summary description of percent hatchery-origin contributions to spawning escapement by source brood year and spawner age. These early results suggest a substantial contribution of hatchery-origin fish to the spawning escapement, ranging from approximately 22% age 5 spawners from brood year 1997 to almost 80% of age 3 spawners from brood year 1998. Also shown in Table 25 is percent of total returning escapement used as hatchery brood stock in each brood year. As adults return in subsequent broods, more complete results that better define the contribution of supplementation-origin fish will be obtained. Table 26 describes adult returns to the Big Quilcene River by originating brood and age; the estimates are of combined supplementation-origin and natural-origin fish.

<b>Table 25.</b> Age-specific percent hatchery-origin fish in the total resulting escapement to Big Quilcene River, observed from adipose-clips.				
<b>Parent brood</b>	<b>Age 3</b>	<b>Age 4</b>	<b>Age 5</b>	<b>Percent of parent brood total escapement spawned at Quilcene NFH</b>
1997	62.2%	45.0%	21.8%	7%
1998	79.5%	68.1%	--	20%
1999	39.1%	--	--	5%

<b>Table 26.</b> Big Quilcene River summer chum salmon brood returns, related to originating brood							
<b>Brood year</b>	<b>Total adults contributing <sup>1</sup></b>	<b>Hatchery release</b>	<b>Resulting escapement, number at age</b>				<b>Total resulting escapement</b>
			<b>2 yr</b>	<b>3 yr</b>	<b>4 yr</b>	<b>5 yr</b>	
1988	120	0	--	--	710	95	805
1989	1	0	--	24	25	9	58
1990	6	0	0	8	44	0	52
1991	49	0	8	661	189	0	858
1992	734	216,441	7	4,331	8,712	362	13,412
1993	136	24,784	0	365	482	14	861
1994	722	343,550	173	6,995	938	0	8,106
1995	4,520	441,167	34	1,833	1,240	0	3,107
1996	9,250	612,598	7	1,913	4,996	149	7,065
1997	7,874	340,744	0	634	4,265	116	5,015
1998	2,792	343,530	0	1,760	664	--	>= 2,424
1999	3,153	181,711	0	3,237	--	--	> 3,237

<sup>1</sup> Includes natural escapement and hatchery broodstock.

*Broodstocking and egg sources* - To represent the demographics of the donor population, Quilcene broodstock were collected as the fish arrived in Quilcene Bay and/or at a permanent trap operated by US Fish and Wildlife Service at QNFH.

Since the inception of the supplementation program in 1992, age and length information has been collected from adults processed at the hatchery. No trends in age or length are apparent (see Tables 27 and 28). The high mean ages of source adults in 1992 and 1993 (Table 28) reflect the strength of the 1988 brood year.

<b>Table 27.</b> Mean fork length of adult summer chum to Big Quilcene, hatchery observations applied to total return.				
<b>Source brood</b>	<b>Mean fork length, mm</b>			
	<b>Source adults</b>		<b>Returning adults</b>	
	<b>Females</b>	<b>Males</b>	<b>Females</b>	<b>Males</b>
1989	--	--	602	611
1990	--	--	642	642
1991	--	--	640	670
1992	619	660	653	703
1993	624	645	658	687
1994	632	667	622	650
1995	603	641	663	702
1996	677	721	666	708
1997	623	654	665	724

<b>Table 28.</b> Mean age of adult summer chum to Big Quilcene, hatchery observations applied to total return.						
<b>Source brood</b>	<b>Mean age, years</b>					
	<b>Source adults</b>			<b>Returning adults</b>		
	<b>Combined</b>	<b>Females</b>	<b>Males</b>	<b>Combined</b>	<b>Females</b>	<b>Males</b>
1989	--	--	--	3.7	4.0	3.4
1990	--	--	--	3.8	4.0	3.8
1991	--	--	--	3.2	3.2	3.2
1992	4.0	4.0	3.9	3.7	3.7	3.7
1993	4.5	4.7	4.4	3.6	3.6	3.6
1994	3.1	3.1	3.1	3.1	3.1	3.1
1995	3.0	3.0	3.1	3.3	3.4	3.3
1996	3.9	4.0	3.9	3.7	3.7	3.8
1997	3.1	3.2	3.1	3.9	3.9	3.9

### GENERAL PROGRAM ASSESSMENT

High levels of adult returns appear to be associated with the supplementation program. In fact, escapement of the Big/Little Quilcene stock has exceeded the escapement criterion for program reduction. The criterion is that the annual total of hatchery-origin and natural-origin escapement exceed the mean 1974-1978 escapement for four consecutive years (section 3.2.2.b of SCSCI). The Big/Little Quilcene mean escapement for 1974 through 1978 is 2,607 spawners. Table 29 shows annual escapement exceeds that level every year, beginning in 1995, the first year of adult returns from the supplementation project. The Co-managers agreed to reducing the program production target to up to 300,000 fed fry for brood year 2002 and then to up to 250,000 fed fry for brood year 2003.

Consistent with the standards set in the SCSCI and HGMP, the intended maximum duration of the program is 12 years (3 generations) beginning with brood year 1992. Accordingly, the last brood year of the Big Quilcene River program will be 2003.

<b>Table 29.</b> Total escapement to Big Quilcene AND Little Quilcene rivers (natural spawners and hatchery spawned).	
<b>Return year</b>	<b>Total escapement</b>
1974	839
1975	2,273
1976	3,533
1977	1,594
1978	4,794
mean 74-78	2,607
1979	455
1980	529
1981	222
1982	281
1983	276
1984	143
1985	45
1986	27
1987	79
1988	297
1989	2
1990	6
1991	50
1992	743
1993	148
1994	722
1995 <sup>1</sup>	4,574
1996	9,515
1997	7,903
1998	3,053
1999	3,237
2000	5,898
2001	6,373
2002	4,487
<sup>1</sup> First year of returns from supplementation program.	

### ***BIG BEEF CREEK***

The Big Beef Creek project began with brood year 1996 when eyed eggs of Quilcene stock were transferred from Quilcene National Fish Hatchery (QNFH) to Big Beef Creek to initiate and support the reintroduction of a summer chum population there.

## ANNUAL PRODUCTION

A summary of the production for each brood year of the project is provided in Table 30.

Brood year	Males	Females	Total	Natural spawners	Percent removed	No. eyed eggs from QNFH <sup>1</sup>	No. fed fry released	Release size (gm)	Release date
1996	-- <sup>1</sup>	-- <sup>1</sup>	-- <sup>1</sup>	0	--	168,000 <sup>2</sup>	204,000	0.5-0.7	2/7, 3/7/97
1997	-- <sup>1</sup>	-- <sup>1</sup>	-- <sup>1</sup>	0	--	157,000	100,280	0.8	2/9/98
1998	-- <sup>1</sup>	-- <sup>1</sup>	-- <sup>1</sup>	0	--	217,465	214,936	1.1-1.6	2/23, 3/15, 3/29/99
1999	-- <sup>1</sup>	-- <sup>1</sup>	-- <sup>1</sup>	4	--	40,298	39,800	1.4	3/10/00
2000	9	11	20	0	100%	81,672 <sup>3</sup>	80,550	1.4-1.8	2/26, 3/13/01
2001	34	34	68 <sup>4</sup>	826	7.6%	--	80,925	1.4-1.7	3/4, 3/14, 3/25/02
2002	32	33	65 <sup>4</sup>	677	8.8%	--	72,622	1.2-1.8	3/4, 3/18, 3/27/03

<sup>1</sup> Eyed eggs received from Quilcene National Fish Hatchery (QNFH).  
<sup>2</sup> Also received 40,000 swim-up fry from QNFH.  
<sup>3</sup> Includes 26,172 eyed eggs from Big Beef Cr. fish and 55,500 eyed eggs from QNFH.  
<sup>4</sup> Includes 2 broodstock mortalities in 2001 and 2 broodstock mortalities in 2002.

## MONITORING AND EVALUATION

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

*Fish marking and mark recovery* - Beginning with brood year 1998, the otoliths of summer chum salmon embryos produced in the reintroduction program on Big Beef Creek were thermally mass-marked (otolith-marked) prior to release as fry to distinguish them from other summer chum. Since 1999, a permanent trap was operated each season throughout the summer chum return to enumerate spawners and to collect information on fish origin and age composition (see Section 2, Stock Assessment). No adipose-clipped adults from the Quilcene supplementation program were recovered in Big Beef Creek during 2000, 2001, and 2002 (Tables 11 and 13). During 2001, of otolith-marked adults recovered from the Big Beef Creek reintroduction program, 91% were recovered in Big Beef Creek, with small numbers recovered in Little Anderson Creek, Lilliwaup Creek, and Hamma Hamma River (Table 12). During 2002, 78% of otolith-marked adults recovered from the Big Beef Creek reintroduction program were recovered in Big Beef Creek, and some were recovered in Lilliwaup Creek, Hamma Hamma River, Dosewallips River, and Chimacum Creek. (Table 14). Otolith-marked adults from the Salmon Creek and Hamma Hamma supplementation programs were recovered in Big Beef Creek during 2001 or 2002 (Tables 12 and 14).

*Adult returns* - The Big Beef Creek reintroduction program has been successful in generating new returns of adult summer chum to a watershed where the original population had become extinct. An estimated 4, 20, 894, and 742 summer chum returned to spawn in Big Beef Creek during 1999, 2000, 2001, and 2002, respectively (Table 30). The first natural spawning by summer chum in Big Beef Creek since the early-1980's occurred during 2001 and 2002 (excepting the four spawners of 1999).

*Broodstocking and egg sources* - From 1996 through 1999, all summer chum eggs incubated and released at Big Beef Creek were transferred from QNFH (Table 30). During 2000, a total of 26,890 green eggs (which resulted in 26,172 eyed eggs) were obtained from female summer chum returning to Big Beef Creek and 55,500 eyed eggs were transferred from QNFH. To foster local adaptation of the reintroduced population, adults returning to Big Beef Creek during 2001 and 2002 were used as broodstock, and no eggs were transferred from QNFH. Broodstock are collected randomly as the fish arrive at the trap location, proportional to the timing, weekly abundance, and duration of the total return to the creek. Since the trap is located near the most downstream point of observed natural spawning activity, nearly the entire run is available for trapping, decreasing the risk that fish trapped through the program are not representative of the total run. Trap data are presented in Appendix Report 1.

### GENERAL PROGRAM ASSESSMENT

The Big Beef Creek summer chum reintroduction program has generally been successful in collecting a representative sample of brood stock from the Quilcene River summer chum population (1996-2000) and from Big Beef Creek returns (2001-2002). It is still early to judge the success of adult returns, but the numbers of summer chum adults returning during 2001 and 2002 are encouraging. The Co-managers will continue to monitor the adult returns. Consistent with the standards set in the SCSCI and HGMP, the expected duration of the program is a maximum of 12 years (3 generations) beginning with brood year 1996.

The Big Beef reintroduction project has addressed the program objectives described in section 3.2.3.4 of the SCSCI during 1999 and 2000 (WDFW and PNPTT 2001) and again during 2001 and 2002. However, no study has been implemented to identify and compare wild and hatchery-origin chum spawner productivity, and survival from out-migration to adult return (Objective 4).

### **LILLIWAUP CREEK**

A supplementation program began on Lilliwaup Creek in 1992 as a cooperative project between HCSEG and WDFW. In 1994, LLTK assumed the role of the primary project operator. Through 1997, there were difficulties in collecting adequate numbers of brood stock from Lilliwaup Creek. Attempts in this regard were complicated by the lack of a fish collection trap, low overall summer chum return levels, and the presence (in odd-numbered years) of pink salmon in the same stream areas as summer chum. Beginning in 1998, WDFW was able to provide limited funding for this project, allowing for the installation of a trap in the lower creek, increased agency assistance during fish spawning, and increased monitoring and evaluation of the supplementation program.

## ANNUAL PRODUCTION

A summary of the production for each brood year of the project is provided in Table 31.

Brood year	Broodstock			Natural spawners	Percent removed	Fed fry released	Release size (gms)	Release date
	Males	Females	Total					
1992	--	--	18	90	16.7%	20,000	0.4	March
1993	--	--	10	72	12.2%	12,000	fed	March
1994	--	--	12	105	10.3%	15,000	fed	March
1995	--	--	0	79	0.0%	0	--	--
1996	--	--	12	40	23.1%	15,000	fed	March
1997	11	7	18	10	64.3%	14,200	1.0	3/1/98
1998	9	12	21	3	87.5%	17,200	0.7	2/24/99
1999	7	6	13	0	100.0%	17,400	1.5	3/11/00
2000	13	7	20	2	90.9%	14,800	1.4	3/12/01
2001	42	18	60 <sup>1</sup>	32	65.2%	38,000	1.1	3/15/02
2002	43	40	83	734	10.2%	96,000	1.2	3/21/03

<sup>1</sup> Includes 20 broodstock mortalities (all males due to lack of females).

## MONITORING AND EVALUATION

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

*Fish marking and mark recovery* - Beginning with brood year 1997, the otoliths of summer chum salmon embryos produced in the supplementation program on Lilliwaup Creek were thermally mass-marked (otolith-marked) prior to release as fry to distinguish them from other summer chum. Since 1998, a temporary fish trap was operated each season throughout the summer chum return to enumerate spawners and to collect information on fish origin and age composition (see Section 2, Stock Assessment). During 2000, no otolith-marked adults from the Lilliwaup supplementation program were recovered (Table 10). During 2001, of otolith-marked adults recovered from the Lilliwaup Creek supplementation program, 91% were recovered in Lilliwaup Creek, and one adult (expanded estimate of two) was recovered in Jimmycomelately Creek. Otolith-marked adults from the Big Beef Creek, Salmon Creek, and Jimmycomelately Creek supplementation programs were also recovered in Lilliwaup Creek (Table 12). During 2002, 91% of otolith-marked adults recovered from the Lilliwaup Creek supplementation program were recovered in Lilliwaup Creek, and some were recovered in Little Lilliwaup Creek, Hamma Hamma River, and Duckabush River (Table 14). Otolith-marked adults from the Big Beef Creek and Hamma Hamma supplementation programs were also recovered in Lilliwaup Creek (Table 14). Adipose (AD)-clipped adults from the Quilcene supplementation program were observed in Lilliwaup Creek during 2001 (pers. comm., R. Endicott, LLTK), but the numbers of AD-clipped adults and the total number of adults sampled was not recorded. During 2002, one (out of 143) of the adults examined in Lilliwaup Creek was AD-clipped (Table 13).

*Adult returns* - The Lilliwaup Creek supplementation program contributed to the return of adult summer chum during 2001 and 2002. Few summer chum returned to Lilliwaup Creek through 2000, but adult returns increased to 92 fish in 2001 and 817 fish in 2002 (Table 31).

*Broodstocking and egg sources* - To represent the demographics of the donor population at the current low population levels, up to 100% of the summer chum returning to Lilliwaup Creek may be used as broodstock. During 1999, 2000, and 2001, all or nearly all of the summer chum returning to Lilliwaup Creek were included in the supplementation program (Table 31). During 2002, the return of summer chum increased substantially, 83 broodstock were collected for the program, and 734 summer chum spawned naturally in Lilliwaup; this was the largest natural escapement since 1978. Trap data are presented in Appendix Report 1.

### GENERAL PROGRAM ASSESSMENT

Until 2001 and 2002, adult return levels had not improved since the program began. Program operational improvements begun in 1998 have apparently contributed to increased adult returns. Otolith mark analysis of returning adults is now available. The Co-managers will continue to monitor the adult returns. According to the standards set in the SCSCI and HGMP, the expected duration of the program is a maximum of 12 years (3 generations). The original program began in 1992, however, due to the lack of adequate broodstock collection until 1998 and only recent indications of population recovery, the Co-managers are discussing whether to consider 1998 as the first effective year of the program and extend the program beyond the original 12-year maximum.

The Lilliwaup supplementation project has generally addressed the program objectives described in section 3.2.3.4 of the SCSCI.

### **HAMMA HAMMA RIVER**

The Hamma Hamma multi-species salmonid recovery project was developed by HCSEG with support from others. Out of this effort evolved the Hamma Hamma summer chum supplementation project on John Creek, a Hamma Hamma River tributary. A review of freshwater habitat conditions, summer chum escapements, potential causes for decline in escapement, and current restoration efforts in Hood Canal by the Co-managers and cooperators, led to the recommendation to initiate the summer chum supplementation project, beginning with brood year 1997.

### ANNUAL PRODUCTION

A summary of the production for each brood year of the project is provided in Table 32.

### MONITORING AND EVALUATION

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

**Table 32.** Hamma Hamma River summer chum supplementation program, brood years 1997-2002.

Brood year	Broodstock			Natural spawners	Percent removed	Fed fry released	Release size (gms)	Release date
	Males	Females	Total					
1997	9	5	14	104	11.8%	12,000	1.0	3/1/98
1998	15	17	32	95	22.4%	2,800	1.0	3/15/99
1999	21	22	43	210	16.9%	51,600	1.1-1.5	3/11, 3/25/00
2000	30	26	56	173	24.4%	55,400	1.1-1.2	3/12, 3/20/01
2001	27	27	54	1,173	4.4%	49,500	1.0	3/4, 3/7, 3/15/02
2002	34	34	68	2,260	2.9%	61,000	1.0-1.2	2/26, 3/5, 3/20/03

*Fish marking and mark recovery* - Beginning with brood year 1997, the otoliths of summer chum salmon embryos produced in the supplementation program on Hamma Hamma River were thermally mass-marked (otolith-marked) prior to release as fry to distinguish them from other summer chum. During 2000, of 10 age-3 adults sampled, two were otolith-marked and eight were unmarked; both otolith-marked fish were from the Hamma Hamma supplementation program (Table 10). During 2001, no otolith-marked adults were recovered from the Hamma Hamma supplementation program (Table 12); and, a few otolith-marked adults from the Big Beef Creek and Salmon Creek supplementation programs were recovered in the Hamma Hamma River (Table 12). During 2002, 85% of otolith-marked adults recovered from the Hamma Hamma supplementation program were recovered in the Hamma Hamma, and some were recovered in Big Beef Creek, Lilliwaup Creek, Duckabush River, and Dosewallips River (Table 14). Otolith-marked adults from the Big Beef Creek and Lilliwaup supplementation programs were recovered in the Hamma Hamma River during 2002 (Table 14). Adipose (AD)-clipped adults from the Quilcene supplementation program were observed in the Hamma Hamma River during 2001 (pers. comm., R. Endicott, LLTK), but the numbers of AD-clipped adults and the total number of adults sampled was not recorded. During 2002, 5% of the adults examined in Hamma Hamma River were AD-clipped (Table 13).

*Adult returns* - The Hamma Hamma River supplementation program contributed to the return of adult summer chum during 2000 and 2002; no otolith marked fish from the program were recovered during 2001.

#### GENERAL PROGRAM ASSESSMENT

It appears that the Hamma Hamma River summer chum supplementation program was generally successful in collecting a representative sample of brood stock from the natural Hamma Hamma River summer chum population. Consistent with the standards set in the SCSCI and HGMP, the expected duration of the program is a maximum of 12 years (3 generations) beginning with brood year 1997. It is too early in the program to assess the success of adult returns, but over 1,000 adults produced in the program returned to the Hamma Hamma River during 2002. The Co-managers are monitoring the returns.

The Hamma Hamma supplementation project has addressed the program objectives described in section 3.2.3.4 of the SCSCI during 2001 and 2002.

## ***UNION RIVER***

The Union River supplementation program is a cooperative effort between the Hood Canal Salmon Enhancement Group and WDFW and was initiated in brood year 2000. The goal is to reintroduce and restore a healthy, natural, self-sustaining population of summer chum in the Tahuya River. The strategy is to boost the abundance of the Union River population to allow for transfers of surplus fish for a reintroduction of summer chum on the Tahuya River using Union River stock. The supplementation program, its goal, objectives, and guidelines are presented in an HGMP consistent with the SCSCI.

### **ANNUAL PRODUCTION**

A summary of the production for each brood year of the project is provided in Table 33.

<b>Brood year</b>	<b>Broodstock</b>			<b>Natural spawners</b>	<b>Percent removed</b>	<b>Fed fry released</b>	<b>Release size (gms)</b>	<b>Release date</b>
	<b>Males</b>	<b>Females</b>	<b>Total</b>					
2000	30	32	62	682	8.3%	75,876	1.0	2/21, 2/27/01
2001	32	32	64	1,486	4.3%	73,472	1.0	2/21, 2/27/02
2002	32	33	65	807	7.5%	82,636	1.0	3/3, 3/10, 3/20/03

### **MONITORING AND EVALUATION**

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

*Fish marking and mark recovery* - Brood year 2000 was the first year of the Union River supplementation program. The otoliths of summer chum salmon embryos produced in the program were thermally mass-marked (otolith-marked) prior to release as fry to distinguish them from naturally-spawned summer chum in the Union River. During 2000, 2001, and 2002, a permanent trap was operated throughout the summer chum return to enumerate spawners and to collect information on fish origin and age composition (see Section 2, Stock Assessment). No adipose-clipped adults from the Quilcene supplementation program were recovered in Union River during 2000, 2001, and 2002 (Tables 11 and 13). Collection of otoliths from adults returning to the Union River will be initiated in 2003 when the first age 3 adults from the Union River supplementation program are expected to return.

*Adult returns* - Summer chum adults originating from the supplementation program are not expected to return until 2003, as three year olds. Since the program was initiated, spawner escapements (including broodstock) have been 744 adults in 2000, 1,550 adults in 2001 and 872 adults in 2002.

*Hatchery survival rates* - The Union River summer chum program has generally been successful in meeting the survival rate objectives. The number of eggs, swim-up fry, and fry released and

the survival rates by life stage for summer chum reared in the supplementation program at Huson Springs facility and George Adams Hatchery from 2000 through 2002 are presented in Table 34.

**Table 34.** Number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum salmon reared in the Union/Tahuya reintroduction program, 2000 through 2002 brood years.

Brood Year	Facility	Green eggs <sup>1</sup>	Eyed eggs	Swim-up fry	Fry released	% Survival by life stage			Commutative % survival		
						Green egg to eyed egg	Eyed egg to swim-up	Swim-up to release	Green egg to eyed egg	Green egg to swim-up	Green egg to release
2000	G. Adams	42,539	40,359	40,311	39,997	94.9%	99.9%	99.2%	94.9%	94.8%	94.0%
	Huson site	42,538	40,358	39,816	35,879	94.9%	98.7%	90.1%	94.9%	93.6%	84.3%
2001	G. Adams	41,824	37,906	37,731	37,214	90.6%	99.5%	98.6%	90.6%	90.2%	89.0%
	Huson site	41,824	37,906	37,786	36,258	90.6%	99.7%	96.0%	90.9%	90.3%	86.7%
2002	G. Adams	44,699	43,195	42,670	41,833	96.6%	98.8%	98.0%	96.6%	95.5%	93.6%
	Huson site	44,698	43,195	43,189	40,753	96.6%	100.0%	94.4%	96.6%	96.6%	91.2%

<sup>1</sup> All green eggs are incubated at WDFW George Adams Hatchery; half are shipped as eyed eggs to the Huson remote site.

*Broodstocking and egg sources* - Fish not retained for use as broodstock are released upstream of the trap site to spawn naturally. The trap is located near the most downstream point of observed natural spawning activity; nearly the entire run is available for trapping, decreasing the risk that fish trapped through the program are not representative of the total run. Trap data are presented in Appendix Report 1.

The average weight of female summer chum salmon, egg size, fecundity, egg loss, and sex ratio for broodstock used in the Union River supplementation program, 2000 through 2002, are shown in Table 35.

**Table 35.** Average summer chum salmon female weight, egg size, fecundity, egg loss, and sex ratio for broodstock used in the Union River supplementation program, 2000 through 2002.

Brood year	Average adult female weight (lbs)	Average green egg sample (#/lb.)	Average eyed egg sample (#/lb.)	Average fecundity (eggs/female)	Average % egg loss	Male::female ratio (%) in trap
2000	7.11	1,990	1,774	2,659	5.12%	42.9::57.1
2001	6.95	2,050	1,827	2,614	9.37%	47.5::52.5
2002	6.90	2,082	1,842	2,798	3.52%	53.0::47.0
Average	6.99	2,041	1,814	2,690	6.00%	47.1::52.9

*Fish Health* - Fish health exams found bacterial gill disease in fry at the Huson Springs site again during 2001 and 2002; treatment was successful. To reduce the risk of bacterial gill disease at Huson Springs, changes to the incubation and rearing systems are being designed and will be implemented for the 2003 brood year.

## GENERAL PROGRAM ASSESSMENT

It appears that the Union River summer chum supplementation program was generally successful in collecting a representative sample of brood stock from the natural Union River summer chum population. The Union River supplementation project has addressed the program objectives described in section 3.2.3.4 of the SCSCI during 2001 and 2002. The phase of the project to reintroduce summer chum into the Tahuya River will begin with brood year 2003.

### **STRAIT OF JUAN DE FUCA REGION**

#### **SALMON CREEK**

The supplementation program, begun on Salmon Creek in 1992, was originally conceived with the objectives to rebuild and stabilize the Salmon Creek population and to allow for the transfer of surplus eggs or fry to reintroduce summer chum to Chimacum Creek.

#### ANNUAL PRODUCTION

A summary of the production for each brood year of the project is provided in Table 36.

Brood year	Broodstock			Natural spawners	Percent removed	Fed fry <sup>1</sup> released	Release size <sup>1</sup> (gms)	Release date
	Males	Females	Total					
1992	35	27	62	371	14.3%	19,200	1.1	5/7/93
1993	29	23	52	400	11.5%	44,000	1.8	4/27/94
1994	12	12	24	137	14.9%	2,000	1.3	3/31/95
1995	35	18	53	538	9.0%	38,808	1.3	4/23/96
1996	59	50	109	785	12.2%	62,000 <sup>2</sup>	1.3	4/8, 4/24/97
1997	60	50	110	724	13.2%	71,821 <sup>2</sup>	1.0-1.3	3/31, 4/16/98
1998	65	56	121	1,023	10.6%	67,832 <sup>2</sup>	1.0-1.3	3/31, 4/21, 5/4/99
1999	34	31	65	434	13.0%	34,680 <sup>2</sup>	1.3-2.6	4/23, 6/12/00
2000	71	65	136	710	16.1%	90,435 <sup>2</sup>	0.6-1.1	4/14, 4/26/01
2001	77	77	154	2,484	5.8%	18,110 <sup>2</sup>	1.0-1.1	4/18, 4/27/02
						72,870 <sup>3</sup>	0.35	3/1/02-4/18/02
2002	64	64	128	5,389	2.3%	118,347 <sup>2,3</sup>	0.35	2/19/03-3/28/03

<sup>1</sup> Release number and size data from Wild Olympic Salmon (1997; 1998) and WDFW files.  
<sup>2</sup> Release numbers do not include 28,788; 36,840; 70,050; 39,170; 73,200; 79,500; and 57,300 fry of Salmon Creek-origin, released into Chimacum Creek in 1997, 1998, 1999, 2000, 2001, 2002, and 2003, respectively.  
<sup>3</sup> Unfed fry release from remote site incubators; for BY 2002, includes 33,880 unfed fry transferred from Hurd Creek Hatchery and released directly into Salmon Creek.

#### MONITORING AND EVALUATION

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

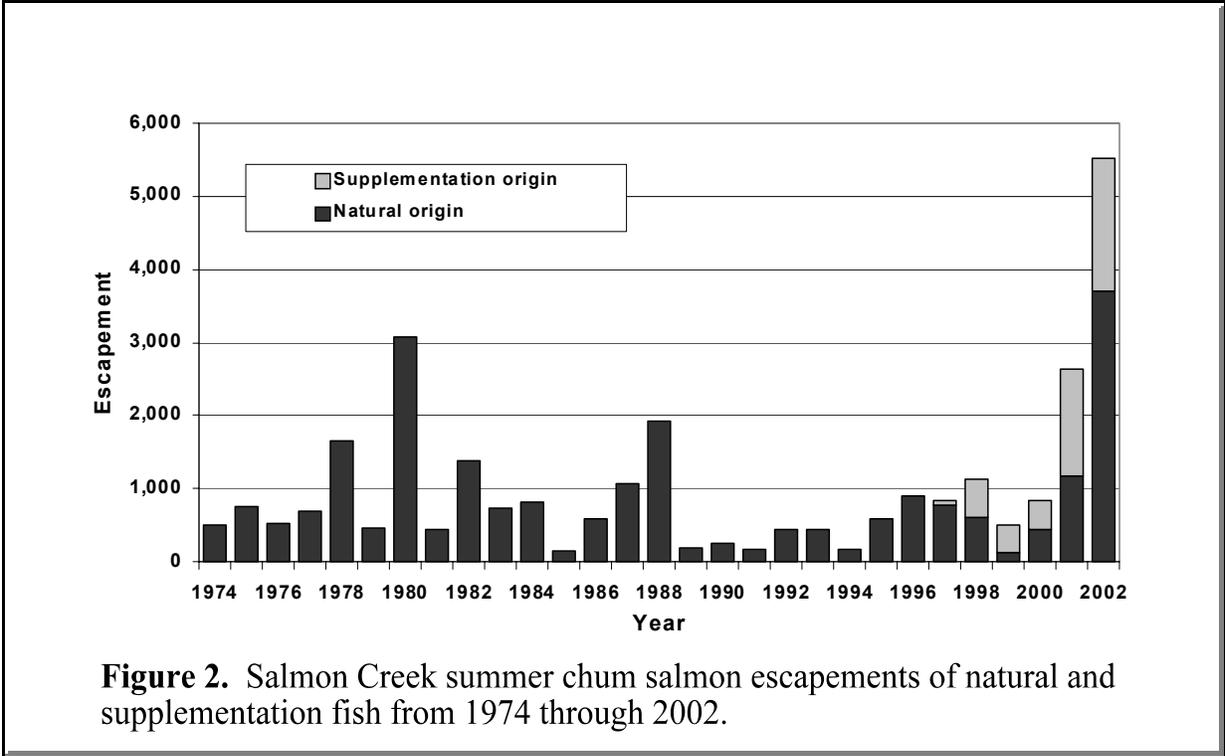
*Fish marking and mark recovery* - The otoliths of summer chum salmon embryos produced in the supplementation program on Salmon Creek are thermally mass-marked (otolith-marked)

prior to release. Spawning ground surveys were conducted throughout the summer chum return to enumerate spawners and to collect information on fish origin and age composition (see Section 2, Stock Assessment). Of otolith-marked adults recovered from the Salmon Creek supplementation program during 2000, 93% were recovered in Snow Creek or Salmon Creek (these two streams support the same stock) and some were recovered in Chimacum Creek and Little Quilcene River (Table 10). During 2001, 92% of otolith-marked adults recovered from the Salmon Creek supplementation program were recovered in Snow Creek or Salmon Creek. Salmon Creek program adults were also recovered in Jimmycomelately Creek, Chimacum Creek, Little Quilcene River, Hamma Hamma River, Lilliwaup Creek, and Big Beef Creek (Table 12). In 2002, 92% of otolith-marked adults recovered from the Salmon Creek supplementation program were recovered in Snow Creek or Salmon Creek, and some were recovered in Chimacum Creek (Table 14). In 2000 and 2001, no otolith-marked or adipose-clipped adults from other supplementation programs were recovered in Salmon or Snow creeks (Tables 11 and 13). In 2002, one individual from the Chimacum supplementation program, and one individual from the Jimmycomelately supplementation program were recovered in Salmon Creek.

*Adult returns* - The Salmon Creek supplementation program has been very successful in contributing to the return of adult summer chum. Estimates of the number of otolith-marked adults and survival from fed fry to spawner for summer chum reared in the supplementation program at Salmon Creek are presented in Table 37 for the 1994 through 1999 **brood** years and in Table 38 for the 1997 through 2002 **return** years. The return rate from fry release to adult return was 4.8%, 1.6%, 0.6%, 1.5%, and 2.1% for the 1994, 1995, 1996, 1997, and 1998 brood years, respectively. Return rate has been 3.2% for two- and three-year-olds of brood year 1999; age 4 adults will return during 2003 (Table 37). The supplementation program contributed an estimated 66, 529, 367, 407, 1,464, and 1,787 adults during the 1997, 1998, 1999, 2000, 2001, and 2002 return years, respectively (Table 38). Supplementation-origin adults comprised from 32% to 73% of the total return to Salmon Creek from 1998 through 2002 (Table 38). It is important to note that the otolith marks were considered by Jeff Grimm of the WDFW Otolith Lab to be “difficult to recognize” (differing only slightly from the natural otolith patterns of wild specimens) for the 1993 and 1994 brood years. Thus, the number, percentage and return rate for age 3 adults in 1997 and age 4 adults in 1998 produced from the supplementation program are possibly underestimated in Tables 37 and 38.

The abundance of natural-origin spawners in Salmon Creek has increased from a mean of 194 adults during 1989-1991 (just prior to initiation of supplementation) to a mean of 1,781 adults during 2000-2002. The number of supplementation-origin recruits and natural-origin recruits to Salmon Creek increased substantially during 2001 and 2002 (Table 39 and Figure 2). The 3,730 natural-origin recruits in Salmon Creek during 2002 exceeded the previous recorded high of 3,074 natural-origin recruits in 1980.

Over time as sufficient age data are collected, the data can be used to develop estimates of age-specific returns of natural origin recruits and lead to development of productivity estimates for each stock (see Section 3, Stock Assessment).



**Figure 2.** Salmon Creek summer chum salmon escapements of natural and supplementation fish from 1974 through 2002.

**Table 37.** Return from fry to adult for summer chum salmon reared in supplementation program at Salmon Creek, as determined from otolith marks for the 1994 through 1999 brood years.

Stream	Brood year	No. fry released	Return year	Age	Number otolith-marked adults	Return rate by age
Salmon Cr.	1994	2,000	1996	2	--	--
			1997	3	46	2.30%
			1998	4	50	2.50%
			1999	5	0	0.00%
			<b>Total</b>	<b>96</b>	<b>4.80%</b>	
	1995	38,800	1997	2	13	0.03%
			1998	3	471	1.21%
			1999	4	148	0.38%
			2000	5	5	0.01%
			<b>Total</b>	<b>637</b>	<b>1.62%</b>	
	1996	62,000	1998	2	8	0.01%
			1999	3	219	0.35%
			2000	4	162	0.26%
			2001	5	0	0.0%
			<b>Total</b>	<b>389</b>	<b>0.62%</b>	
	1997	71,800	1999	2	0	0.0%
			2000	3	231	0.32%
			2001	4	727	1.17%
			2002	5	0	0.00%
			<b>Total</b>	<b>958</b>	<b>1.49%</b>	
1998	67,800	2000	2	14	0.02%	
		2001	3	698	1.03%	
		2002	4	709	1.05%	
		2003	5			
		<b>Total</b>	<b>1,421</b>	<b>2.10%</b>		
1999	34,680	2001	2	39	0.11%	
		2002	3	1,078	3.11%	
		2003	4			
		2004	5			
		<b>Total</b>	<b>1,117</b>	<b>3.22%</b>		

**Table 38.** Return from fry to adult for summer chum salmon reared in supplementation program at Salmon Creek, as determined from otolith marks for the 1997 through 2002 return years.

Return year	Total return	Age	Age comp (%)	No. of adults	Otolith marks		Supplementation program		
					(%)	No.	Brood year	No. fry released	Return rate by age
1997	834	2	3.6%	30	44.4%	13	1995	38,800	0.03%
		3	64.3%	536	8.6%	46	1994	2,000	0.29%
		4	30.5%	255	2.7%	7	1993	44,000	0.02%
		5	1.6%	13	0.0%	0	--	--	--
						<b>7.9%</b>	<b>66</b>		
1998	1134	2	0.7%	8	100.0%	8	1996	62,000	0.01%
		3	60.0%	680	69.2%	471	1995	38,800	1.21%
		4	39.3%	446	11.2%	50	1994	2,000	2.50%
		5	0.0%	0	0.0%	0	1993	44,000	0.00%
						<b>46.6%</b>	<b>529</b>		
1999	499	2	0.0%	0	0.0%	0	1997	71,800	0.00%
		3	58.2%	282	75.2%	219	1996	62,000	0.35%
		4	40.7%	197	72.9%	148	1995	38,800	0.38%
		5	1.1%	5	0.0%	0	1994	2,000	0.00%
						<b>73.4%</b>	<b>367</b>		
2000	846	2	6.0%	51	27.3%	14	1998	67,800	0.02%
		3	64.5%	546	42.3%	231	1997	71,800	0.32%
		4	29.0%	245	66.0%	162	1996	62,000	0.26%
		5	0.5%	4	0.0%	0	1995	38,800	0.00%
						<b>48.1%</b>	<b>407</b>		
2001	2638	2	4.4%	116	33.3%	39	1999	34,680	0.06%
		3	42.6%	1,125	62.1%	698	1998	67,800	0.97%
		4	52.9%	1,397	52.1%	727	1997	71,800	1.17%
		5	0.0%	0	0.0%	0	1996	62,000	0.00%
						<b>55.5%</b>	<b>1464</b>		
2002	5517	2	0.0%	0	0.0%	0	2000	90,435	0.00%
		3	77.7%	4,286	25.2%	1,078	1999	34,680	3.11%
		4	22.1%	1,219	58.2%	709	1998	67,800	1.05%
		5	0.0%	12	0.0%	0	1997	71,800	0.00%
						<b>32.4%</b>	<b>1,787</b>		

**Table 39.** Natural-origin recruits and supplementation-origin recruits in the spawner escapement to Salmon Creek, 1997 through 2002 return years.

Return year	Natural-origin recruits in spawner escapement	Supplementation-origin recruits in spawner escapement	Total spawner escapement
1997	768 (92%)	66 (8%)	834
1998	605 (53%)	529 (47%)	1,134
1999	132 (27%)	367 (73%)	499
2000	439 (52%)	407 (48%)	846
2001	1,174 (44%)	1,464 (56%)	2,638
2002	3,730 (68%)	1,787 (32%)	5,517

*Hatchery survival rates* - The Salmon Creek summer chum program has generally been successful in meeting the survival rate objectives. The number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum reared in the supplementation program at Salmon Creek Hatchery from 1992 through 2002 are presented in Table 40.

**Table 40.** Number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum salmon reared in the supplementation program at Salmon Creek Hatchery, 1992 through 2002 brood years.

Brood year	Number of eggs or fry					% Survival by life stage			Cumulative % survival	
	Total		Salmon Cr. Hatchery			Salmon Cr. Hatchery			Salmon Cr. Hatchery	
	Green eggs	Eyed eggs	Eyed eggs	Swim-up fry	Fry released	Green egg to eyed egg	Eyed egg to swim-up	Swim-up to release	Green egg to release	Eyed egg to release
1992	46,980	44,280	44,280	18,684	19,200	94.3	42.2	100.0	39.8	42.2
1993	--	46,300	46,300	26,837	44,000	--	58.0	100.0	--	58.0
1994	--	24,200	24,200	2,000	2,000	--	8.3	100.0	--	8.3
1995	41,750	39,200	39,200	38,808	38,808	93.9	99.0	100.0	93.0	99.0
1996	--	114,900 <sup>1</sup>	64,900	62,300	62,000	--	96.0	99.5	--	95.5
1997	133,340	112,900 <sup>1</sup>	72,900	71,011	71,821	87.7	97.4	100.0	85.4	97.4
1998	164,300	149,100 <sup>1</sup>	69,100	68,423	67,807	90.7	99.0	99.1	89.0	98.1
1999	87,350	78,300 <sup>1</sup>	29,200	28,950	28,400 <sup>2</sup>	89.6	99.1	98.1	87.1	97.2
2000	174,550	165,400 <sup>1</sup>	91,350	90,755	90,435	94.8	99.3	99.6	93.8	98.9
2001	198,685	177,150 <sup>1</sup>	93,309	92,644	92,415	89.2	99.3	99.7	88.3	99.0
2002	184,450	177,150 <sup>1</sup>	119,150	--	117,797	96.0	--	98.9	94.9	98.9

<sup>1</sup> Total includes eggs taken for both Salmon Creek supplementation and Chimacum Creek reintroduction programs; all green eggs are incubated at Dungeness Hatchery and shipped as eyed eggs to Salmon Creek Hatchery and Chimacum Creek Hatchery.

<sup>2</sup> Does not include 6,300 fish transferred in June 1 at 256 fpp from Dungeness Hatchery and 6,280 released on June 12 at 175 fpp at RM 0.1 in Salmon Creek after rearing in freshwater there; total release was 34,680 fish for BY 1999.

*Broodstocking and egg sources* - To represent the demographics of the donor population, summer chum broodstock are collected randomly as the fish arrive at a temporary fish trap operated by WDFW, Wild Olympic Salmon, and North Olympic Salmon Coalition, proportional to the timing, weekly abundance, and duration of the total return to the creek. Fish not retained for use as broodstock are released upstream of the trap site to spawn naturally. Trap data are presented in Appendix Report 1.

#### GENERAL PROGRAM ASSESSMENT

There were substantial increases in the number of natural-origin adults returning in 2001 and 2002, as a result of the supplementation project on that stream. Some natural summer chum production is occurring in Salmon Creek, however, it appears that impacts to natural processes in freshwater and/or estuarine habitats are likely limiting summer chum production in the stream in some years. This re-emphasizes the need for the Salmon Creek summer chum recovery program to address all factors affecting summer chum production, including habitat, harvest, and supplementation. Several habitat restoration and acquisition projects have recently been funded and are being implemented in the freshwater and estuarine areas of Salmon Creek and Discovery Bay. Completion of these projects will help restore habitat function and are expected to increase

summer chum production and productivity. Harvest management strategies and regimes identified in the Summer Chum Salmon Conservation Initiative are expected to result in, on the average, a total exploitation rate of 8.8% on the Salmon/Snow Creek management unit (observed rates have actually been less than the expected rate); this relatively low exploitation rate should contribute to the recovery of Salmon Creek summer chum. As noted, above, the supplementation program has already contributed substantially to the summer chum adult return to Salmon Creek.

The Salmon Creek supplementation project has addressed the program objectives described in section 3.2.3.4 of the SCSCI during 2001 and 2002.

### ***CHIMACUM CREEK***

Chimacum Creek supported an indigenous summer chum population until the mid-1980s, when a combination of habitat degradation and poaching evidently led to its demise (WDFW and PNPTT 2000). In 1992, Wild Olympic Salmon initiated a project to boost the number of summer chum in the Salmon Creek stock so it could be used as a donor stock to reintroduce summer chum into Chimacum Creek. Beginning with brood year 1996, eyed eggs from the Salmon Creek broodstock were transferred to, and released from, Chimacum Creek hatchery facilities to reintroduce summer chum to formerly occupied habitat.

### **ANNUAL PRODUCTION**

A summary of the production for each brood year of the project is provided in Table 41.

<b>Table 41.</b> Chimacum Creek summer chum reintroduction program, brood years 1996-2002.				
<b>Brood year</b>	<b>No. eggs received</b>	<b>No. fed fry released</b>	<b>Release size (gm)</b>	<b>Release date</b>
1996	50,000	28,788	0.4-1.5	3/23, 5/9/97
1997	40,000	36,840	0.7	3/27, 4/11, 4/19/98
1998	80,000	70,050	0.6-0.8	3/26, 3/28, 4/21/99
1999	41,300	39,170	0.4-0.8	3/20, 3/31, 4/7, 4/24/00
2000	74,050	73,300	0.8-1.2	4/5, 4/17, 4/18, 4/23, 5/3, 5/10/01
2001	82,490	71,500	0.9-1.8	4/18, 4/27, 4/30, 5/2/02
		8,000 <sup>1</sup>	0.35	3/12/02
2002	58,000	57,300	0.9-1.0	3/4, 3/15, 3/19, 3/23/03

<sup>1</sup> Unfed fry released accidentally into tributary to Chimacum Creek due to tank overflow.

### **MONITORING AND EVALUATION**

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

*Fish marking and mark recovery* - Beginning with brood year 1999, the otoliths of summer chum salmon embryos produced in the supplementation program on Chimacum Creek were thermally mass-marked (otolith-marked) prior to release to distinguish them from naturally-

spawned summer chum in Chimacum Creek. Spawning ground surveys were conducted throughout the summer chum return to enumerate spawners and to collect information on fish origin and age composition (see Section 2, Stock Assessment). In 2002, 79% of the recoveries of Chimacum Creek reintroduction fish occurred in Chimacum Creek; the remainder were recovered in Salmon Creek. In 2000, 2001, and 2002, otolith-marked adults from the Salmon Creek supplementation program (the donor stock for the Chimacum reintroduction program) were recovered in Chimacum Creek (Tables 10, 12, and 14). No adipose-clipped adults from the Quilcene supplementation program were recovered in Chimacum Creek during 2000, 2001, or 2002 (Tables 11 and 13).

*Adult returns* - The Chimacum Creek reintroduction program has been successful in contributing to the return of adult summer chum to a previously occupied stream. An estimated 38, 52, 903, and 864 summer chum returned to spawn in Chimacum Creek during 1999, 2000, 2001, and 2002, respectively (Appendix Table 2). This was the first natural spawning by summer chum in Chimacum Creek since the mid-1980s. Estimates of the number of reintroduction program adults and survival from fed fry to spawner for summer chum reared in the reintroduction program at Chimacum Creek are presented in Table 42 for the 1996 through 1999 **brood** years and in Table 43 for the 2000 through 2002 **return** years. The return rate from fry release to adult return was 0.01%, 1.2%, and 1.3% for the 1996, 1997, and 1998 brood years, respectively (1998 brood total does not include age 5 return). Return rate has been 0.12% for three-year-olds of brood year 1999; age 4 adults will return during 2003 (Table 42). The reintroduction program contributed an estimated 35, 815, and 557 adults which comprised 67.3%, 90.3%, and 64.5% of the total return during the 2000, 2001, and 2002 return years, respectively (Table 43). The 38 summer chum adults which spawned naturally in Chimacum Creek in 1999 contributed an estimated 119 age 3 adults during 2002.

**Table 42.** Return from fry to adult for summer chum salmon reared in reintroduction program at Chimacum Creek, as determined from otolith marks for the 1996 through 1999 brood years.

Stream	Brood year	No. fry released	Return year	Age	Number	
					reintroduction program adults	Return rate by age
Chimacum Cr.	1996	28,788	1998	2	--	--
			1999	3	--	--
			2000	4	4	0.01%
			2001	5	0	0.00%
			<b>Total</b>	<b>4</b>	<b>0.01%</b>	
	1997	36,840	1999	2	--	--
			2000	3	25	0.07%
			2001	4	400	1.09%
			2002	5	24	0.07%
	<b>Total</b>	<b>449</b>	<b>1.22%</b>			
	1998	70,050	2000	2	6	0.01%
			2001	3	415	0.59%
			2002	4	485	0.69%
			2003	5		
			<b>Total</b>	<b>906</b>	<b>1.29%</b>	
	1999	39,170	2001	2	0	0.0%
2002			3	48	0.12%	
2003			4			
2004			5			
<b>Total</b>			<b>48</b>	<b>0.12%</b>		

**Table 43.** Number of summer chum salmon adults recovered in Chimacum Creek produced in the Chimacum Creek reintroduction program, as determined from otolith marks for the 2000 through 2002 return years.

Return year	Total return	Age	Age comp. (%)	Total no. of adults	Reintroduction program			
					No. of program adults <sup>1</sup>	Brood year	No. fry released	Return rate by age
2000	52	2	11.4%	6	6	1998	70,050	0.01%
		3	51.4%	27	25	1997	36,840	0.07%
		4	37.1%	19	4	1996	28,788	0.01%
		5	0.0%	0	--			
		<b>35 (67.3%)</b>						
2001	903	2	0.0%	0	0	1999	39,170	0.0%
		3	49.2%	444	415	1998	70,050	0.59%
		4	50.8%	459	400	1997	36,840	1.09%
		5	0.0%	0	0	1996	28,788	0.0%
		<b>815 (90.3%)</b>						
2002	864	2	0.6%	5	0	2000	73,300	0.0%
		3	38.7%	334	48	1999	39,170	0.12%
		4	58.0%	501	485	1998	70,050	0.69%
		5	2.8%	24	24	1997	36,840	0.07%
		<b>557 (64.5%)</b>						

<sup>1</sup> Number of summer chum adults produced from Chimacum Creek reintroduction program.

*Hatchery survival rates* - The Chimacum Creek summer chum program has generally been successful in meeting the survival rate objectives. The number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum reared in the supplementation program at Chimacum Creek Hatchery from 1996 through 2002 are presented in Table 44.

**Table 44.** Number of eggs, swim-up fry, and fry released and the survival rates by life stage for summer chum salmon reared in the reintroduction program at Chimacum Creek Hatchery, 1996 through 2002 brood years.

Brood year	Number of eggs or fry					% Survival by life stage				
	Total <sup>1</sup>		Chimacum Cr. Hatchery			Chimacum Cr. Hatchery				
	Green eggs	Eyed eggs	Eyed eggs	Swim-up fry	Fry released	Green eggs to eyed eggs	Eyed egg to swim-up	Swim-up to release	Green egg to release	Eyed egg to release
1996	--	114,900	50,000	31,243	28,788	--	62.5	92.1	--	57.6
1997	133,340	112,900	40,000	38,000	36,840	84.7	95.0	96.9	78.0	92.1
1998	164,300	149,100	80,000	73,750	70,050	90.7	92.2	95.0	79.5	87.6
1999	87,350	78,300	41,300	40,880	39,170	89.6	99.0	95.8	85.0	94.8
2000	174,550	165,400	74,050	--	73,300	94.8	--	--	93.8	99.0
2001	198,685	177,150	83,841	--	71,750	89.2	--	--	76.3	85.6
2002	184,450	177,150	58,000	--	<b>57,300</b>	96.0	--	--	94.9	98.8

<sup>1</sup> Total includes eggs taken for both Salmon Creek supplementation and Chimacum Creek reintroduction programs; all green eggs are incubated at Dungeness Hatchery and shipped as eyed eggs to Salmon Creek Hatchery and Chimacum Creek Hatchery.

*Broodstocking and egg sources* - Summer chum broodstock are collected randomly as the fish arrive at a temporary fish trap operated by WDFW, Wild Olympic Salmon, and North Olympic Salmon Coalition on Salmon Creek, proportional to the timing, weekly abundance, and duration of the total return to the creek. Trap data are presented in Appendix Report 1. Eggs from each female used as broodstock are represented in the Chimacum Creek reintroduction program.

#### GENERAL PROGRAM ASSESSMENT

It appears that the Chimacum Creek summer chum reintroduction program has generally been successful in collecting a representative sample of brood stock from the natural Salmon Creek summer chum population and successful in contributing to the return of adult summer chum to Chimacum Creek. Brood year 2001 and 2002 fry were successfully reared to a size of 0.9 to 1.8 grams in the freshwater and saltwater facilities and released during March, April and May. Fry reared at the freshwater and saltwater sites received different otolith marks so the rearing strategies can be evaluated. Since 2000, the program generally met the production targets for number, size, and date of fry released, there has been no significant mortality to unknown causes and fish health condition of fry prior to release has been good. Consistent with the standards set in the SCSCI and HGMP for the program, the expected duration of the program is a maximum of 12 years (3 generations) beginning with brood year 1996. The Co-managers will continue to monitor the adult returns from fry released from the reintroduction program.

The Chimacum Creek reintroduction project has addressed the program objectives described in section 3.2.3.4 of the SCSCI during 2001 and 2002.

## ***JIMMYCOMELATELY CREEK***

The Jimmycomelately (JCL) Creek supplementation project was initiated with the 1999 brood year and is a cooperative effort between WDFW, North Olympic Salmon Coalition, and Wild Olympic Salmon. The SCSCI has noted that habitat impacts are high and may be contributing to the risk, and recommended that habitat protection and recovery measures should be addressed concurrent with supplementation project development. Habitat restoration projects have been prioritized, funded, and initiated in freshwater and estuarine areas of JCL Creek.

### **ANNUAL PRODUCTION**

A summary of the production for each brood year of the project is provided in Table 45.

<b>Brood year</b>	<b>Broodstock</b>			<b>Natural spawners</b>	<b>Percent removed</b>	<b>Fed fry released</b>	<b>Release size (gms)</b>	<b>Release date</b>
	<b>Males</b>	<b>Females</b>	<b>Total</b>					
1999	2	4 <sup>1</sup>	6	1	85.7%	3,880	1.0	4/8/00
2000	33	13	46	9	83.6%	25,900	1.0	4/20, 4/28/01
2001	36	32	68 <sup>2</sup>	192 <sup>3</sup>	26.1%	54,515	0.9-1.2	4/17, 4/26/02
2002	21	15	36 <sup>4</sup>	6 <sup>5</sup>	85.7%	20,887	0.8-1.1	4/7, 4/21/03

<sup>1</sup> Includes two females trapped for brood stock, but not be used because they were spawned out.  
<sup>2</sup> Includes 4 male mortalities in brood stock due to lack of available females.  
<sup>3</sup> An additional 24 pre-escapement adults were lost to predation in the bay and are not included in the total of natural spawners.  
<sup>4</sup> Includes 8 male mortalities due to lack of available females and 1 female mortality in brood stock.  
<sup>5</sup> An additional 15 pre-escapement adults were lost to predation in bay and are not included in the total of natural spawners.

### **MONITORING AND EVALUATION**

Monitoring and evaluation were consistent with the above described, generally applicable monitoring and evaluation actions carried out for all individual projects (see section above titled Project Monitoring and Evaluation). Following are additional details of monitoring and evaluation activities applicable to this project.

*Fish marking and mark recovery* - Beginning with brood year 1999, the otoliths of summer chum salmon embryos produced in the supplementation program on Jimmycomelately (JCL) Creek were thermally mass-marked prior to release to distinguish them from naturally-spawned summer chum in JCL Creek. An adult trap was operated and spawning ground surveys were conducted throughout the summer chum return to enumerate spawners and to collect information on fish origin and age composition (see Section 2, Stock Assessment). Mass marking also makes it possible to determine the level of straying of all supplementation program-origin fish to other drainages. During 2001, otolith-marked adults from the Lilliwaup and Salmon Creek supplementation programs were recovered in JCL Creek (Table 12). During 2002, of otolith-marked adults recovered from the JCL Creek supplementation program, 69% were recovered in JCL Creek, and some were recovered in the Dosewallips River; and no otolith-marked adults from other supplementation programs were recovered in JCL Creek (Table 14). No adipose-

clipped adults from the Quilcene supplementation program were recovered in JCL Creek during 2000, 2001, or 2002 (Tables 11 and 13).

*Adult returns* - This program is only in its fourth year of operation. The Jimmycomelately Creek supplementation program contributed to the return of adult summer chum during 2002. Of the 57 adults which returned (Table 45), 55 were age 3 fish from the supplementation program (Table 14); representing a substantial increase compared to the 1999 parent brood.

*Hatchery survival rates* - The Jimmycomelately Creek summer chum program has generally been successful in meeting the survival rate objectives (WDFW data on file).

*Broodstocking and egg sources* - To represent the demographics of the donor population at the current extremely low population levels, the intent is to use 100% of the summer chum returning to Jimmycomelately Creek as broodstock. A temporary adult trap (operated by WDFW, Wild Olympic Salmon, and North Olympic Salmon Coalition) is located near the most downstream point of observed natural spawning activity; nearly the entire run is available for trapping, decreasing the risk that fish trapped through the program are not representative of the total run. During 1999, 2000, and 2002, all or nearly all of the summer chum returning to Jimmycomelately Creek were included in the supplementation program (Table 45). During 2001, the return of summer chum was 260 adults; 68 broodstock were collected for the program and 192 summer chum spawned naturally in Jimmycomelately Creek. Trap data are presented in Appendix Report 1.

#### GENERAL PROGRAM ASSESSMENT

It appears that the JCL Creek summer chum supplementation program has been generally successful in collecting a representative sample of brood stock from the natural JCL Creek summer chum population. Consistent with the standards set in the SCSCI and HGMP, the expected duration of the program is a maximum of 12 years (3 generations) beginning with brood year 1999. The Co-managers will monitor the adult returns from fry released from the supplementation program.

The Jimmycomelately Creek supplementation project has addressed the program objectives described in section 3.2.3.4 of the SCSCI during 2001 and 2002.

## **5 - ECOLOGICAL INTERACTIONS**

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The SCSCI addressed two specific areas of potentially adverse effects on summer chum from ecological interactions: artificial production and marine mammal predation. Recommendations were made to address negative interactions associated with artificial production and there was acknowledgment that further study was needed to help identify possible future actions to mitigate predation impacts of marine mammals. Following are updates of progress in these two areas of concern.

### **HATCHERIES**

The SCSCI assessed potential effects of existing hatchery programs upon summer chum in four categories: hatchery operations, predation, competition/behavior modification, and fish disease (SCSCI, section 3.3.2.1). Hatchery programs for individual salmonid species (other than summer chum) were rated as high, medium or low risk for designated hazards within each category. Those programs with hazards of high or medium risk were assigned specific risk aversion and monitoring/evaluation mitigation measures that if implemented would reduce the hazards to low risk.

For the most part, little has changed in 2001 and 2002 regarding compliance with the mitigation measures last reported in SCSCI Supplementation Report No. 3 (WDFW and PNPTT 2001) for the years 1999 and 2000. Table 44 lists the existing hatchery programs within the summer chum region and shows the risk aversion and monitoring/evaluation mitigation measures to be met by each program that was determined to have one or more hazards of high or medium risk (the table describes the mitigation measures in abbreviated form; expanded descriptions of the measures are provided in Appendix 5 of this report and complete descriptions are available in section 3.3.2.1 of the SCSCI). The table duplicates Table 3.15 of the SCSCI, except that strikeouts show the programs that have been discontinued (only two additional programs have been discontinued since the 1999/2000 report - Johnson Creek [Duckabush] chinook fingerlings and Quilcene NFH coho fingerlings). Also, Table 44 shows the status of implementing the mitigation measures in both 2001 and 2002 by the accompanying symbols (in bold font): **Y** = yes, measure(s) was implemented, **N** = no, measure(s) was not implemented, **Y/N** = partial implementation of the measure(s), or **NA** = not applicable. More detailed descriptions of the individual program's status in meeting the mitigation measures are provided in Appendix Report 5.

A few measures are not being implemented or only partially implemented, however, the situation has improved since the last report (i.e., for years 1999 and 2000, WDFW and PNPTT 2001). These instances have occurred primarily with citizen group projects (Table 44) and are due primarily to project results not being reported by the operators and to how fish health monitoring has been done. There is some redundancy between hazard categories (e.g., recording and reporting of fish production information is stipulated under both the categories of Hatchery Operations and Predation). To facilitate prompt reporting of project results, WDFW intends to 1) continue to include language requiring a timely fish production report in annual contracts with project operators (that fall within the citizen group classification of Table 44), at the risk of project termination; and 2) make follow-up contacts as necessary.

Currently, WDFW does not routinely monitor fish health during the rearing of juvenile fish by citizen group projects (the exception is for summer chum projects), and there is no pre-release health certification. However, the WDFW pathologists do respond to any requests or concerns expressed about fish health by the project operators. It is assumed that there is low risk of unmonitored fish disease incidents with this approach; however, it does not fully meet the specified measures addressing fish health in the hazard categories and, therefore, only partial implementation is indicated in Table 46. Because the risk appears to be relatively low, no change in the WDFW's current protocol is planned. Project-specific information regarding the mitigation measures is provided in Appendix Report 3.

**Table 46.** Summary description for the years 2001 and 2002 of Risk Aversion (r.a.) And Monitoring and Evaluation measures planned for artificial propagation programs in the Hood Canal summer chum region. Abbreviations “Y”, “N”, or “Y/N” shown in parentheses next to each measure indicate: “yes”, the measure was implemented, “no” the measure was not implemented, or “yes and no” the measure was partially implemented (see specific comments in Appendix Report 3). “NA” means the measure was not applicable. Strike-outs indicate the project was discontinued.

Hazard Categories and Assigned Risk (criteria # from risk ranking within category applied) <sup>1</sup>						
Agency	Species Project	Release class	Hatchery Operations	Predation	Competition and Behavior Modification	Disease Transfer
<u>Fall Chinook</u>						
<b>WDFW</b>	Hoodsport FH	Fingerling	--	--	--	--
	George Adams FH	Fingerling	--	--	--	--
	Sund Rock Net Pens	Yearling	--	--	r.a. #7, m&c#1	--
<b>Skokomish Tribe</b>	Enetai	Fingerling	--	--	m&c#1	--
<b>Port Gamble Tribe</b>	Little Boston	Fingerling	--	--	--	--
<b>Citizen Groups</b>	Union River	Fingerling	m&c#3-5	m&c#1	r.a.#4, m&c#1, 2	r.a.#4, m&c#1, 2
	Tahuya River	Fingerling	m&c#3-5	m&c#1	r.a.#4, m&c#1, 2	r.a.#4, m&c#1, 2
		Unfed fry	m&c#3-5	m&c#1	r.a.#4, m&c#1, 2	r.a.#4, m&c#1, 2
	Dewatto River	Fingerling	m&c#3-5	m&c#1	r.a.#4, m&c#1, 2	r.a.#4, m&c#1, 2
	Big Beef Creek	Fingerling	m&c#3 (Y/N), 4 (N), 5 (NA)	m&c#1 (N)	r.a.#4 (N); m&c#1 (N)	r.a. #1-4 (Y/N), 2, 4 (Y), 3 (N), m&c1 (Y/N), 2 (Y)
	Skokomish River	Yearling	m&c#3 (Y) 4 (Y/N), 5 (NA)	m&c#1 (Y/N)	m&c#1 (Y)	m&c1 (Y), 2 (Y)
		Fingerling	m&c #3 (Y/N), 4 (Y/N), 5 (NA)	m&c#1	m&c#1 (Y)	m&c1 (Y/N), 2 (Y)
	Hamma Hamma River	Fingerling	r.a.#4 (Y), #6 (Y); m&c#1 2, (Y), 3 (Y/N) 4 (Y), 5 (NA)	m&c#1 (Y)	m&c#1 (Y)	m&c1 (Y/N), 2 (Y)
	Johnson Creek (Duckabush)	Fingerling	m&c#3 (Y/N); 4 (N), 5 (NA)	m&c#1 (N)	m&c#1 (Y)	r.a.#1 (Y/N), 2, 4 (Y); 3 (N); m&c1 (Y/N), 2 (Y)
	Unnamed tribs: Pleasant Harbor Net Pens	Unfed fry Yearling	m&c#3-5 m&c#3-5	m&c#1 m&c#1	m&c#1, 2 r.a.#7, m&c#1	r.a.#1-4, m&c 1,2 m&c1,2
HC Marina Net Pens	Yearling	m&c#3-5	m&c#1	r.a.#7, m&c#1	m&c 1,2	

(Table continues on next page)

Table 46. Continued.

Agency	Species Project	Release class	Hazard Categories and Assigned Risk (criteria # from risk ranking within category applied) <sup>1</sup>			
			Hatchery Operations	Predation	Competition and Behavior Modification	Disease Transfer
<b><i>Chinook</i></b>						
<b>WDFW</b>	Dungeness FH	Fry	--	m&e#2 (Y)	--	--
		Fingerling	--	m&e#2 (Y)	--	--
		Fingerling smolt	--	--	--	--
<b><i>Coho</i></b>						
<b>WDFW</b>	Dungeness FH	Yearling	--	--	--	--
	Pt. Gamble Net pens	Yearling	--	--	r.a.#7 (Y)	--
	Quilcene Net pens	Yearling	--	--	r.a.#7 (Y)	--
	George Adams FH	Yearling	--	--	--	--
	Farboo Creek	Fingerling	--	--	--	--
	Snow Creek	Unfed fry	--	m&e#2 (Y)	m&e#3 (Y)	--
		Presmolts	--	m&e#2 (Y)	m&e#3 (Y)	--
<b>USFWS</b>	Quilcene NFH	Yearling	--	--	--	--
		Fingerling	--	r.a.#2,3	--	--
<b><i>Pink</i></b>						
<b>WDFW</b>	Hoodsport FH	Fed fry	--	r.a.#4 (Y)	r.a.#1, 2 (Y)	--
	Dungeness FH	Fed fry	r.a.#1-5 (NA)	--	r.a.#6 (Y)	--
<b><i>Fall Chum</i></b>						
<b>WDFW</b>	Hoodsport FH	Fed fry	--	r.a.#4 (Y)	r.a.#1, 2 (Y)	--
	George Adams FH	Fed fry	--	--	--	--
	McKenna FH	Fed fry	--	r.a.#4 (Y)	r.a.#1, 2 (Y)	--
<b>Skokomish Tribe</b>	Enctai	Fed fry	--	--	--	--
<b>Pt. Gamble Tribes</b>	Port Gamble FH	Fed fry	--	--	--	--
<b>USFWS</b>	Quilcene NFH	Fed fry	--	--	--	--
<b>Citizen Groups</b>	Mills Creek	Unfed fry	m&e#3-5	m&e#1	r.a.#3, m&e#1-2	r.a.#1; m&e#1,2
	Fahuya River	Unfed fry	m&e#3-5	r.a.#4, m&e#1	r.a.#3, m&e#1-2	r.a.#1; m&e#1,2
	Union River	Unfed fry	m&e#3-5	r.a.#4, m&e#1	r.a.#2, 3; m&e#2	r.a.#1; m&e#1,2
	E. Mission Creek	Unfed fry	m&e#3-5	m&e#1	r.a.#2, m&e#2	r.a.#1; m&e#1,2
	Skull Creek	Unfed fry	m&e#3-5	m&e#1	r.a.#2; m&e#2	r.a.#1; m&e#1,2
	Sweetwater Creek	Unfed fry	m&e#3 (Y/N), 4 (Y), 5 (NA)	m&e#1 (Y)	r.a.#2; m&e#2 (Y)	r.a.#1 (Y/N), 2,4 (Y) 3 (N); m&e1 (Y/N), 2 (Y)
	Unnamed 14.0124 (Grimm)	Unfed fry	m&e#3 (Y/N), 4 (Y), 5 (NA)	m&e#1 (Y)	r.a.#2; m&e#2 (Y)	r.a.#1 (Y/N), 2,4 (Y) 3 (N); m&e1 (Y/N), 2 (Y)
	Chinom Pt. (Ck)	Unfed fry	m&e#3-5	m&e#1	r.a.#2; m&e#2	r.a.#1-4; m&e 1,2
	Unnamed 12.0136 (Hood Canal Schools, formerly Adams)	Unfed fry	m&e#3 (Y/N), 4 (Y), 5 (NA)	m&e#1 (Y)	r.a.#2; m&e#2 (Y)	r.a.#1 (Y/N), 2,4 (Y) 3 (N); m&e1 (Y/N), 2 (Y)
	Skokomish River	Unfed fry		r.a.#4; m&e#1	r.a.#2; m&e#2	r.a.#1-4; m&e 1,2
	Jump-off Joe Creek	Unfed fry	m&e#3-5	m&e#1	r.a.#2; m&e#2	r.a.#1-4; m&e 1,2
	Unnamed 14.0124 (Mulberg, formerly Koopman)	Unfed fry	m&e#3 (Y/N, 4 (Y), 5 (NA)	m&e #1 (Y)	r.a.#2; m&e#2 (Y)	r.a.#1 (Y/N), 2, 4 (Y), 3 (N); m&e 1 (Y/N) 2 (Y)

(Table continues on next page)

**Table 46.** Continued.

		<b>Hazard Categories and Assigned Risk</b> (criteria # from risk ranking within category applied) <sup>1</sup>				
Agency	<u>Species</u> Project	Release class	Hatchery Operations	Predation	Competition and Behavior Modification	Disease Transfer
<u>Steelhead</u>						
<b>WDFW</b>	Skokomish River	Yearling	--	r.a.#1-3 (Y)	--	--
	Dosewallips River	Yearling	--	r.a.#1,2 (Y), 3 (Y/N)	--	--
	Duckabush River	Yearling	--	r.a.#1,2 (Y), 3 (Y/N)	--	--
	Dungeness FH	Yearling	--	r.a.#1-3 (Y)	--	--
<b>Citizen Groups</b>	Hamma Hamma R.	2+ Yearling	r.a.#4, 6 (Y); m&e#1,3 (Y/N), 2,4 (Y), 5 (NA)	r.a.#1,2 (Y/N), 3 (Y); m&e#1 (Y)	m&e#3 (NA)	m&e#1 (Y/N), 2 (Y)

<sup>1</sup> Risk aversion (“r.a.”) and monitoring and evaluation (“m&e”) measures indicated as required for each project are keyed by number to measure applicable to each hazard described in section 3.3.2.1 of the Summer Chum Salmon Conservation Initiative.

## **MARINE MAMMALS**

The WDFW began evaluating adverse effects of predation by pinnipeds on summer chum and other salmon species of Hood Canal in late 1998. The study continued through 2001, but then was terminated. A preliminary report on results of these efforts through 1999 was provided in Supplemental Report No. 3 (Jeffries et al. 2000 in WDFW and PNPTT 2001), and Appendix Report 6 (below) summarizes study results for the four years of monitoring (London et al. 2003).

The field study is being resurrected in 2003, partly in response to movement of transient killer whales into Hood Canal in the early part of the year. The killer whales preyed upon harbor seals for approximately six weeks and appear to have substantially reduced the pinniped population (Jeffries, personal communication). This event has generated considerable interest in the condition of the remaining harbor seal population and its current effects on salmon resources. The Co-managers will monitor results of the WDFW study with respect to harbor seal impacts on summer chum populations.

## 6 - HABITAT

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Recovery of summer chum requires effective habitat protection and restoration measures be undertaken in the watersheds and estuaries of Hood Canal and eastern Strait of Juan de Fuca. Section 3.4 of the SCSCI provides guidance and direction for pursuit of such measures with 1) an initial analysis of factors limiting summer chum habitat in the watersheds and sub-estuaries, 2) descriptions of habitat protection and restoration strategies, 3) recommendations for monitoring and research, and 4) a discussion of implementation focusing on what participants and their roles are needed for effective habitat protection and improvement. Appendix Report 3.6 of the SCSCI provides detailed information on the results of the habitat analysis and recommendations for recovery specific to individual watersheds. It is understood that actions involving land use management and regulation, as well as restoration, require a wide range of participants and processes, and will take time to implement. Long term commitments are necessary to adequately protect and recover the summer chum. Following are descriptions of progress with actions that can benefit summer chum and other species.

- The Washington Department of Ecology updated new state shoreline management guidelines in 2000. These guidelines were challenged and then invalidated by the Shoreline Hearings Board, leading to The Department of Ecology initiating and completing a mediation process to reach a legal settlement. Consistent with the results of the mediation, Ecology will propose new guidelines and the mediation participants will jointly seek supportive legislation for the new guidelines in 2003. Updating of shoreline master programs (SMP) by local jurisdictions has been slow, at least in part because of uncertainty about the state-wide guidelines. One exception is the City of Port Townsend. The City is moving ahead with development of an SMP that may serve as a benchmark for development of other SMPs in the Hood Canal and eastern Strait of Juan de Fuca.
- Watershed planning under House Bill 2514 is underway for all the WRIAs of the summer chum ESU. The planning process is intended primarily to address water quantity and quality issues; however, concerns about effects on aquatic resources, including ESA-listed species such as summer chum, would also be addressed. It is too early in the planning processes to determine potential benefits to summer chum. Also, there is some question about how effective the planning efforts will be, given the new water bills passed by the State in 2003.
- Kitsap County took the initiative in developing a salmon plan intended to protect salmon resources and provide an exemption for county land use programs under the ESA 4(d) rule. The plan was initially comprehensive and in many ways consistent with recommendations of the SCSCI. Owing in part to lack of support from the federal and state agencies, the plan has since been modified and land use regulatory measures to protect salmon resources are no longer as strong as they had been.
- The Hood Canal Coordinating Council and North Olympic Peninsula Lead Entity have served as the lead entities (under House Bill 2496 and Senate Bill 5595) in Hood Canal and the Strait of Juan de Fuca to coordinate local project proposals for funding by the Washington State Salmon Recovery Funding Board. These two organizations have

developed procedures for prioritizing project proposals within their respective areas, in cooperation with tribes, local and state agencies, and non-governmental organizations. The SCSCI has been used in developing strategies for recovery planning; for example, the Hood Canal Coordinating Council's "Salmon Habitat Recovery Strategy for the Hood Canal and Eastern Strait of Juan de Fuca" (Hood Canal Coordinating Council 2001).

- New projects addressing salmon restoration have been recently completed or are under way. Many of these projects are funded by the State's Salmon Recovery Funding Board, though other funding resources are also being used. The majority of the projects benefit from support or sponsorship of local organizations and volunteers. New projects, since the 1999/2000 report (WDFW and PNPTT 2001), that benefit summer chum salmon include:
  - Large woody debris restoration and riparian plantings on the Tahuya, Dewatto and Union rivers by the Hood Canal Salmon Enhancement Group.
  - Bourgault Channel restoration in Skokomish River flood plain by Skokomish Tribe.
  - Restoration of the Skokomish River estuary by the Skokomish Tribe and cooperators. Phase I, including tidegate and dike removal begins in 2003. Phase II, involving restoration of Nalley Island begins in 2004.
  - Acquisition of 150 acres in the lower Skokomish River's flood plain by the Skokomish Tribe for habitat protection and restoration.
  - Decommissioning Lebar Creek Road on the South Fork Skokomish River to remove a source of eroded sediments, by the Hood Canal Salmon Enhancement Group and U.S. Forest Service.
  - Acquisition of over 30 acres of estuarine habitat (Nick's Lagoon) near the mouth of Seabeck Creek by the Seabeck/Alki Stream Team and Kitsap county, to protect against future development.
  - Big Quilcene land preservation by Jefferson County. Land parcels are being acquired on the north side of the lower river by the County to facilitate restoration of the stream channel and flood plain. Flood control benefits are also expected.
  - First phase of engineered log jam restoration project on the Big Quilcene by Skokomish Tribe and landowner. Project includes reach analysis and planning, followed by a pilot program that places a single channel-spanning log jam to assess potential for its long-term retention, and sediment capture capabilities. Project may lead to larger scale restoration effort.
  - Program to protect and preserve habitat in Chimacum Creek's lower mainstem and estuary by Chumsortium, a group including WDFW, tribes, local agencies and non-governmental-organizations that was formed to protect and restore summer chum salmon habitat. Work is being done in cooperation with landowners and includes use of federal Conservation Reserve Enhancement Program (CREP).
  - Acquisition of 150 acres of land at the mouths of Salmon and Snow creeks by Chumsortium. Plans are to restore estuarine and riverine habitat on the land.
  - Restoration of salmon habitat in Jimmycomelately Creek by reconfiguring its stream channel and estuary. Project is being implemented by Jamestown S'Klallam Tribe and other cooperators.
  - Estuarine restoration at Indian George Creek in Quilcene Bay, including removal of creosoted barges and opening tidewater access to wetland area, by Hood Canal Salmon Enhancement Group and Washington Dept. of Fish and Wildlife.

- A number of habitat studies also have recently been completed or are under way. These studies are intended to improve our understanding of habitat conditions and the need/priority for restoration/protection at specific sites and across the landscape. These studies include:
  - Salmon habitat limiting factors analyses, sponsored by the Washington Conservation Commission, but including participants from WDFW, tribes and non-governmental-organizations. The analyses are applicable to the watershed and nearshore environments of WRIAs 15, 16 and 17 and part of 14, and encompass habitats within nearly the entire Hood Canal summer chum ESU.
  - Salmon habitat refugia analyses of eastern Jefferson County, Mason County and Kitsap County, performed by consultants for the counties.
  - Stream habitat surveys in southern Hood Canal and the Duckabush River by the Hood Canal Salmon Enhancement Group.
  - Linger Longer feasibility study of options for land acquisition to protect/restore habitat in northeastern Quilcene Bay, by Jefferson County.
  - Forage fish inventory along marine shorelines by North Olympic Salmon Coalition.
  - Interpretation and assessment of historical (19<sup>th</sup> century) U.S. Coast & Geodetic Survey shoreline charts and comparison with contemporary maps and photos. Intent is to identify shoreline habitat changes over time and develop a framework for identifying and prioritizing habitat protection/restoration actions. The project, applicable to shorelines of the Hood Canal and Strait, is conducted by the Point No Point Treaty Council in cooperation with agencies and non-governmental-organizations.
  - Collection and analysis of hyperspectral imagery to provide a detailed (to 1.5 m), but at landscape scale, description of the nearshore habitat in Hood Canal. Emphasis of this study is on eelgrass habitat, its distribution and configuration in relation to shoreline development. Project is sponsored by the Point No Point Treaty Council.
  - Detailed salmon habitat assessment of the Dosewallips River by the Port Gamble S’Klallam Tribe.
  - Surveys of juvenile fish presence over time in tidal channels, lagoons and small stream estuaries of Hood Canal by the Port Gamble S’Klallam and Skokomish tribes.



## **7 - CONCLUDING REMARKS**

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The Co-managers generally have been successful in implementing those components of the SCSCI over which they have jurisdiction (including artificial production, ecological interactions and harvest management). Progress is also being made in addressing summer chum salmon habitat needs (outside the Co-managers jurisdiction). Following are brief summaries of progress in the implementation of the SCSCI within the major management categories.

### ***STOCK ASSESSMENT***

The collection of necessary data to generate quality estimates of summer chum escapement and runsize was continued by the Co-managers. A comprehensive schedule of spawning ground counts was conducted on all summer chum streams, and detail of the spawning escapement counts for each stock during 2001 and 2002 are provided in Appendix Report 1. The combination of escapement estimates and sport and net harvests resulted in reliable estimates of runsize, which were generated using the summer chum run re-construction model (see Appendix Report 2).

Biological sampling was conducted on all summer chum stocks, including mark sampling (both fin clips and otolith marks), age sampling (scales), and genetic stock identification (both DNA and allozyme). This sampling was of dead fish or post spawners encountered during spawner surveys and also of broodstock collected for supplementation programs. This conservative approach to sampling frequently resulted in situations where only small numbers of fish were available for sampling, causing sample sizes to be very small (see Tables 5-6). Genetic samples for some stocks may have to be pooled for the next several years or collected over a number of years to achieve useful results.

Three significant WDFW genetic studies for summer chum were recently completed. Kassler and Shaklee (2003) analyzed recently collected and historical allozyme data for summer chum salmon populations in Hood Canal and Strait of Juan de Fuca to assess population interrelationships and to see if the allele frequencies of any of the populations had changed over time. The complete paper is attached as Appendix Report 3. Small and Young (2003) conducted the first genetic analysis of summer and early fall chum salmon populations in Hood Canal, Strait of Juan de Fuca, and South Puget Sound using microsatellite DNA. Appendix Report 4 presents the complete paper. In 2002, standard allozyme GSI analyses were conducted on a sample of 200 chum salmon collected from the Area 7 Reef Net fishery to determine if summer chum were present in that area between the dates of August 1 and September 30. The analysis was conducted by the WDFW Genetics Lab, and results were reported by Kassler (2003).

An up-dated extinction risk assessment was conducted using summer chum census data through the 2000 return. The risk assessment followed the methods presented in SCSCI section 1.7.4 (from Allendorf et al. 1997). The new assessment continued to identify the Jimmycomelately and Lilliwaup stocks to be at a high risk of extinction. All other extant summer chum stocks were at a moderate or low risk of extinction.

## ***HARVEST MANAGEMENT***

The harvest management actions implemented under the SCSCI Base Conservation Regime continue to successfully achieve the plan goal of minimizing harvests of summer chum salmon. As shown in Table 22 above, the fishery exploitation rates in both 2001 and 2002 were below the BCR target rates in all management units but one, and for that management unit (Quilcene), estimated escapements did exceed expected escapement. The primary result of these low rates of fishery harvest is that the escapements of summer chum stocks are generally exceeding 90% of the estimated runsizes. Biological sampling of the summer chum harvested, however, could not be conducted because of the low numbers of fish landed.

## ***ARTIFICIAL PRODUCTION***

In general, the summer chum salmon supplementation and reintroduction programs have been successful in meeting the operational criteria/standards and program objectives described in the SCSCI. The individual project reports contained in the body of the report describe in detail how the criteria/standards and objectives are being met (see Section 4, Artificial Production). The supplementation of Hood Canal and Strait of Juan de Fuca summer chum stocks at risk of extinction has been successful in substantially increasing the abundance of summer chum populations. The reintroduction of summer chum to habitats where the local fish have been extirpated has also demonstrated preliminary success. The most immediate benefit of the increased run sizes and reintroductions has been a reduction in the extinction risk for the targeted stocks.

The ultimate goal of both supplementation and reintroduction projects is the establishment of abundant, self-sustaining populations composed of natural origin recruits. It can potentially take several decades to achieve this goal, and the correction of major factors for decline is necessary for recovery to be achieved. Thus, the results from project monitoring and evaluation activities presented here are considered to be preliminary, since the projects are too recent in origin to draw final conclusions.

## ***ECOLOGICAL INTERACTIONS***

The Co-managers have generally been successful in implementing the provisions addressing risk to summer chum salmon of interactions with hatchery fish (Table 44, and Appendix Report 5). A past problem regarding poor reporting of results for citizen group hatchery projects has now been largely remedied. A WDFW study of seal predation on salmon in summer chum salmon streams suggests that seal predation may be at significant levels in some years (see Appendix Report 6).

## ***HABITAT***

A number of restoration projects and studies specifically addressing or related to the protection and restoration of summer chum salmon are being or soon will be implemented. Improvements in land use management to the benefit of summer chum salmon and other natural resources are

also being considered. Establishing effective protection and restoration measures will take time. Staff of the Co-managers are continuing to participate in various planning processes that affect selection of restoration projects and studies, and work toward improving land use management practices. Part of this Co-manager activity is providing assistance in interpreting provisions of the SCSCI and in understanding the habitat needs of summer chum.



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# APPENDIX

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## APPENDIX TABLES

**Appendix Table 1.** Summer chum salmon spawning escapement estimates in the Hood Canal region (1968-2002).

**Appendix Table 2.** Summer chum salmon spawning escapement estimates in the Strait of Juan de Fuca region (1968-2002).

**Appendix Table 3.** Summary of otoliths examined for marks from adult summer chum salmon sampled in eastern Strait of Juan de Fuca and Hood Canal streams, by age, 2000 return year.

**Appendix Table 4.** Summary of otoliths examined for marks from adult summer chum salmon sampled in eastern Strait of Juan de Fuca and Hood Canal streams, by age, 2001 return year.

**Appendix Table 5.** Summary of otoliths examined for marks from adult summer chum salmon sampled in eastern Strait of Juan de Fuca and Hood Canal streams, by age, 2002 return year.

## APPENDIX REPORTS

**Appendix Report 1.** Derivation of Escapement Estimates For the 2001 and 2002 Returns of Summer Chum Salmon to the Streams of Hood Canal and the Strait of Juan de Fuca

**Appendix Report 2.** Summer Chum Salmon Run Reconstruction 1974-2002 Return Years.

**Appendix Report 3.** An analysis of the genetic characteristics and interrelationships of summer chum in Hood Canal and Strait of Juan de Fuca and of chum in Curley Creek (Puget Sound) using allozyme data

**Appendix Report 4.** A genetic analysis of summer and fall chum salmon populations in Hood Canal, Strait of Juan de Fuca, and South Puget Sound using microsatellite DNA

**Appendix Report 5.** Status of Artificial Production Programs in Meeting Specified Mitigation Measures to Reduce Risk of Negative Interactions with Summer Chum Salmon

**Appendix Report 6.** Investigations of Harbor Seal Predation on Salmonids in Hood Canal, Washington 1998-2001

**Appendix Table 1.** Summer chum salmon escapement estimates in the Hood Canal region (1968-2000). (Excluded values = missing estimates; *Italicized* = estimates based on regression or extrapolation. In broodstock columns excluded values mean no broodstock collected).

Return Year	Big Beef		Anderson Dewatto Tahuya		Union		Lilliwaup		Hamma Hamma		Duckabush Dosewallips		Big/Little Quilcene		
	Wild	Brood Total	Wild	Brood Total	Wild	Brood Total	Wild	Brood Total	Wild	Brood Total	Wild	Brood Total	Big Quil	Little Brood Total	
1968	100		2,275						13,548		4,693		5,797	897	6,694
1969	100		280						3,104		3,802		1,307		
1970	178		65	2,666					1,390		2,301		655	12	667
1971	159		125	2,012			318		4,282		3,904		1,798	71	1,869
1972	177		225	1,403	4,487		716		5,346		13,546	1,733	2,067	300	2,367
1973	244		691								5,761	623	3,107	238	3,345
1974	75		0	181	880	68	616		<b>2,448</b>		3,581	<b>3,593</b>	795	44	839
1975	1,152		195	613	1,389	<b>84</b>	706		<b>7,341</b>		2,245	<b>2,250</b>	1,405	868	2,273
1976	1,281		234	741	3,200	100	1,612		<b>7,648</b>		6,095	3,271	2,445	1,088	3,533
1977	302		<b>26</b>	225	726	75	420		<b>1,675</b>		2,453	3,215	821	773	1,594
1978	680		16	544	266	64	1,331		<b>8,215</b>		1,898	<b>1,901</b>	2,978	1,816	4,794
1979	191		6	49	117	<b>97</b>	163		<b>3,096</b>		1,190	<b>1,190</b>	345	110	455
1980	123		2	117	179	208	247		329		827	1,216	375	154	529
1981	90		1	41	140	41	293		926		557	63	138	84	222
1982	0		<b>0</b>	21	86	<b>153</b>	84		801		690	507	156	125	281
1983	0		0	15	86	170	18		190		80	64	100	176	276
1984	22		1	44	142	194	187		<b>170</b>		299	212	60	83	143
1985	0		0	19	122	334	92		<b>231</b>		30	236	44	1	45
1986	0		0	20	109	1,892	97		173		177	57	15	12	27
1987	6		0	5	91	497	32		26		12	9	8	71	79
1988	0		0	23	145	629	275		440		497	661	120	177	297
1989	0		0	2	9	450	43		16		60	16	1	1	2
1990	0		0	0	6	275	2		90		42	8	6	0	6
1991	0		0	31	5	208	30		71		102	250	49	1	50
1992	0		0	0	0	140	81	18	99	123	617	655	320	9	414
1993	0		0	1	0	251	67	10	77	69	105	105	97	12	39
1994	0		0	0	0	738	99	12	111	370	263	225	349	0	373
1995	0		0	0	0	721	79	0	79	476	825	2,787	4,029	54	491
1996	0		0	0	5	494	64	12	76	774	2,650	6,976	8,479	265	771
1997	0		0	6	0	410	9	18	27	104	475	47	7,339	29	535
1998	0		0	12	0	223	3	21	24	<b>95</b>	226	336	2,244	265	548
1999	0	4	0	2	1	159	0	13	13	212	92	351	2,981	84	172
2000	0	20	0	10	2	682	2	20	22	173	464	1,260	5,126	268	504
2001	826	68	0	32	0	1,426	65	60	92	1,173	942	990	5,868	199	306
2002	677	65	0	10	0	807	65	83	858	2,260	530	1,627	3,662	470	355
		742				872	775	88	2,328						4,487

**Appendix Table 2.** Summer chum salmon escapement estimates in the Strait of Juan de Fuca region (1968-2002).  
*(Excluded values = missing estimates; Italicized = estimates based on regression or extrapolation. In the broodstock columns excluded values mean no broodstock collected).*

Return Year	Jimmycomelately Creek			Snow	Salmon Creek			Chimacum
	Wild	Broodstock	Total		Wild	Broodstock	Total	
1968								
1969								
1970								
1971					249		249	
1972				436	534		534	
1973					636		636	
1974	<i>438</i>		<i>438</i>	818	512		512	
1975	<i>353</i>		<i>353</i>	340	755		755	
1976	<i>365</i>		<i>365</i>	608	521		521	
1977	<i>405</i>		<i>405</i>	538	701		701	
1978	<i>787</i>		<i>787</i>	629	1,664		1,664	
1979	<i>170</i>		<i>170</i>	133	458		458	
1980	<i>1,326</i>		<i>1,326</i>	709	3,074		3,074	
1981	<i>203</i>		<i>203</i>	242	439		439	
1982	599		599	766	1,386		1,386	
1983	254		254	154	731		731	
1984	367		367	384	828		828	
1985	61		61	20	151		151	
1986	292		292	213	582		582	
1987	464		464	465	1,062		1,062	
1988	1,052		1,052	723	1,915		1,915	
1989	173		173	21	194		194	
1990	63		63	33	245		245	
1991	125		125	12	172		172	
1992	616		616	21	371	62	433	
1993	110		110	11	400	52	452	
1994	15		15	2	137	24	161	
1995	223		223	25	538	53	591	
1996	30		30	160	785	109	894	
1997	61		61	67	724	110	834	
1998	98		98	27	1,023	121	1,144	
1999	1	6	7	29	434	65	499	38
2000	9	46	55	30	710	136	846	52
2001	192	68	260	154	2,484	154	2,638	903
2002	6	36	42	532	5,389	128	5,517	864

**Appendix Table 3.** Summary of otoliths examined for marks from adult summer chum salmon sampled in eastern Strait of Juan de Fuca and Hood Canal streams, by age, 2000 return year.

Stream	Return year	Age	No. of readable otoliths	No. of otolith marks observed	Otolith marks (%)
Jimmycomelately Cr. <sup>1</sup>	2000	2	28	0	0.0%
		3	24	0	0.0%
		4	1	0	0.0%
		5	0	0	0.0%
Salmon Cr. <sup>1</sup>	2000	2	11	3	27.3%
		3	111	47	42.3%
		4	50	33	66.0%
		5	1	0	0.0%
Snow Cr.	2000	2	0	0	0.0%
		3	2	0	0.0%
		4	1	1	100.0%
		5	0	0	0.0%
Chimacum Cr. <sup>1</sup>	2000	2	4	0	0.0%
		3	18	1	5.6%
		4	14	9	64.3%
		5	0	0	0.0%
Little Quilcene R.	2000	2	0	0	0.0%
		3	0	0	0.0%
		4	19	1	5.3%
		5	0	0	0.0%
Hamma Hamma R. <sup>1</sup>	2000	2	1	0	0.0%
		3	10	2	20.0%
		4	37	0	0.0%
		5	0	0	0.0%
Lilliwaup R. <sup>1</sup>	2000	2	1	1	100.0%
		3	1	0	0.0%
		4	3	0	0.0%
		5	0	0	0.0%

<sup>1</sup> Supplementation or reintroduction program.

**Appendix Table 4.** Summary of otoliths examined for marks from adult summer chum salmon sampled in eastern Strait of Juan de Fuca and Hood Canal streams, by age, 2001 return year.

Stream	Return year	Age	No. of readable otoliths	No. of otolith marks observed	Otolith marks (%)
Jimmycomelately Cr. <sup>1</sup>	2001	2	1	0	0.0%
		3	88	3	3.4%
		4	28	1	3.6%
		5	0	0	0.0%
Salmon Cr. <sup>1</sup>	2001	2	12	4	33.3%
		3	116	72	62.1%
		4	143	75	52.4%
		5	0	0	0.0%
Snow Cr.	2001	2	0	0	0.0%
		3	34	31	91.2%
		4	16	3	18.8%
		5	0	0	0.0%
Chimacum Cr. <sup>1</sup>	2001	2	0	0	0.0%
		3	46	3	6.5%
		4	47	6	12.8%
		5	0	0	0.0%
Little Quilcene R.	2001	2	2	1	50.0%
		3	34	1	2.9%
		4	33	4	12.1%
		5	1	0	0.0%
Hamma Hamma R. <sup>1</sup>	2001	2	0	0	0.0%
		3	27	6	22.2%
		4	58	0	0.0%
		5	11	0	0.0%
Lilliwaup R. <sup>1</sup>	2001	2	4	3	75.0%
		3	42	28	66.7%
		4	22	8	36.4%
		5	1	0	0.0%
Big Beef Cr. <sup>1</sup>	2001	2	1	0	0.0%
		3	146	142	97.3%
		4	26	0	0.0%
		5	0	0	0.0%
Little Anderson Cr.	2001	2	0	0	0.0%
		3	4	4	100.0%
		4	0	0	0.0%
		5	0	0	0.0%

<sup>1</sup> Supplementation or reintroduction program.

**Appendix Table 5.** Summary of otoliths examined for marks from adult summer chum salmon sampled in eastern Strait of Juan de Fuca and Hood Canal streams, by age, 2002 return year.

Stream	Return year	Age	No. of readable otoliths	No. of otolith marks observed	Otolith marks (%)
Jimmycomelately Cr. <sup>1</sup>	2002	2	0	0	0.0%
		3	50	48	96.0%
		4	0	0	0.0%
		5	0	0	0.0%
Salmon Cr. <sup>1</sup>	2002	2	0	0	0.0%
		3	318	80	25.2%
		4	98	57	58.2%
		5	1	0	0.0%
Snow Cr.	2002	2	0	0	0.0%
		3	61	20	32.8%
		4	19	10	52.6%
		5	0	0	0.0%
Chimacum Cr. <sup>1</sup>	2002	2	0	0	0.0%
		3	72	45	62.5%
		4	102	3	2.9%
		5	0	0	0.0%
Little Quilcene R.	2002	2	0	0	0.0%
		3	55	0	0.0%
		4	12	0	0.0%
		5	2	0	0.0%
Dosewallips R.	2002	2	0	0	0.0%
		3	63	10	15.9%
		4	49	0	0.0%
		5	8	0	0.0%
Duckabush R.	2002	2	0	0	0.0%
		3	60	15	25.0%
		4	19	0	0.0%
		5	3	0	0.0%
Hamma Hamma R. <sup>1</sup>	2002	2	0	0	0.0%
		3	150	94	62.7%
		4	26	2	7.7%
		5	4	0	0.0%
Lilliwaup R. <sup>1</sup>	2002	2	0	0	0.0%
		3	123	119	96.7%
		4	15	13	86.7%
		5	0	0	0.0%
Little Lilliwaup R.	2002	2	0	0	0.0%
		3	2	2	100.0%
		4	0	0	0.0%
		5	0	0	0.0%
Big Beef Cr. <sup>1</sup>	2002	2	3	3	100.0%
		3	143	142	99.3%
		4	53	51	96.2%
		5	1	0	0.0%

<sup>1</sup> Supplementation or reintroduction program.

# *APPENDIX REPORT 1*

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## *DERIVATION OF ESCAPEMENT ESTIMATES FOR THE 2001 AND 2002 RETURNS OF SUMMER CHUM SALMON TO THE STREAMS OF HOOD CANAL AND THE STRAIT OF JUAN DE FUCA*

Escapement estimates for Hood Canal and Strait of Juan de Fuca summer chum populations are based upon the collection and analysis of multiple live and dead fish counts made in each stream throughout the spawning season. An estimate of the total abundance of summer chum in each stream from this data is made by use of an "area-under-the-curve" (AUC) methodology. The AUC escapement methodology is based upon escapement curves developed from serial spawner counts, which are converted into total escapement estimates for the surveyed stream using the average chum salmon spawner residence life. Other methods, such as rack and redd counts were also used where available and/or appropriate. For a more detailed discussion see SCSCI [Appendix Report 1.1](#).

The following are the 2001 and 2002 return year summaries of the summer chum spawner count data, quality ratings, and the procedures used for estimating escapement. Beginning in 2002, data for many surveys were entered into palm pilot computers in the field, rather than by hand on the traditional survey cards. As a result, data from 2002 are presented in a slightly different format. Survey data directly used in estimation process are highlighted with **bold text** in the annual summary tables.

Survey data are presented here for several small streams that were not included in the 2000 Annual Report (WDFW and PNPTT, 2001). Some of these streams were identified as possibly being part of the historic distribution of summer chum salmon based on limited past observations of chum salmon spawners during typical summer chum time periods. In these cases, there was insufficient evidence to determine whether each represented a self sustaining population (see SCSCI 1.7.2.3, WDFW and PNPTT, 2000). These streams are now monitored to determine if summer chum colonization is currently occurring, and/or if summer chum adults returning from supplementation programs may be straying to these watersheds.

# 2001 SUMMER CHUM NATURAL SPAWNING ESCAPEMENT SUMMARY

## LITTLE ANDERSON CREEK (WRIA 15.0377)

### Summer Chum 2001

**Reach** River mile 0.0-0.7  
**Estimate** 10  
**Method** 9/25 dead count + 9/27 live count  
**Quality rating** Good  
**Comments** Regular surveys in September and early October by volunteers with the Kitsap Stream Team (KST). Evidence of predation, only 2 live fish seen. Of 4 chum sampled by WDFW, all 4 were otolith marked from the BY 1998 supplementation program in nearby Big Beef Creek.

**Table 1.1.** Little Anderson Creek 2001 chum survey data through Nov. 10.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species	Comments	Agency
15 0377	09/11/2001	0.0	0.7	0.7	0	0	0	90	SUPP	FOOT	0 0 0 0	20 30 00	KST
15 0377	09/17/2001	0.0	0.7	0.7	0	8	8	70	SUPP	FOOT	0 0 0 0	24 12 60	KST
15 0377	09/25/2001	0.0	0.7	0.7	0	8	8	70	SUPP	FOOT	0 0 0 0	76 42 25	KST
15 0377	09/27/2001	0.0	0.3	0.3	2	5	7	95	SUPP	FOOT	4 0 0 0	20 60 00	WDFW
15 0377	10/04/2001	0.0	0.7	0.7	0	0	0	90	SUPP	FOOT	4 6 0 0	23 32 00	KST
15 0377	10/10/2001	0.0	0.7	0.7	0	1	1	90	SUPP	FOOT	0 0 0 0	34 24 60	KST

Notes:  
 09/17 - Carcasses were in pieces and/or dragged on shore. Probably more dragged away from stream.  
 09/25 - More evidence of predation. No redds seen, many eggs around carcasses.

## BIG BEEF CREEK (WRIA 15.0389)

### Summer Chum 2001

**Reach** River mile 0.0 upstream  
**Estimate** 826  
**Method** Trap count - (broodstock take adjustment)  
**Quality rating** Very good  
**Comments** Trap operated by WDFW from August 23 through the fall chum run; October 15 set as end of summer chum run. 68 fish were used for broodstock, including 2 mortalities. No spawning observed downstream of the trap (pers. comm., S. Neuhauser, WDFW). Total return = (826 natural esc.) + (68 broodstock) = 894.

**Table 1.2.** 2001 chum trapping totals from Big Beef Creek trap (through Oct. 15).

Date	Released upstream		To hatchery		Total	
	Male	Female	Male	Female	Male	Female
8/23/01	1	1			1	1
8/24/01	1	1			1	1
8/27/01	2	1			2	1
9/3/01			1		1	
9/6/01			3	1	3	1
9/7/01	7		2	2	9	2
9/8/01			2	3	2	3
9/9/01			2	1	2	1
9/10/01	9	2	1	1	10	3
9/11/01	2			4	2	4
9/12/01	7	3	2		13	6
9/13/01	14	14			14	14
9/14/01	10	6			6	3
9/15/01	35	19			35	19
9/16/01	20	19			20	19
9/17/01	27	12	8	6	35	18
9/18/01	16	14		3	16	17
9/19/01	24	21			24	21
9/20/01	30	15			30	15
9/21/01	32	12			32	12
9/22/01	24	22			24	22
9/23/01	14	12			14	12
9/24/01	14	22			14	22
9/25/01	20	13			20	13
9/26/01	20	9	8	8	28	17
9/27/01	35	17			35	17
9/28/01	24	15			24	15
9/29/01	16	9			16	9
9/30/01	23	12			23	12
10/1/01	11	4	5	3	16	7
10/2/01	16	9		2	16	11
10/3/01	20	12			20	12
10/4/01	8	2			8	2
10/5/01	6	2			6	2
10/6/01	7	5			7	5
10/7/01	3	4			3	4
10/8/01	4	3			4	3
10/9/01	2	2			2	2
10/10/01	2	2			2	2
10/12/01	1	1			1	1
10/15/01	1	1			1	1
<b>Total</b>	<b>508</b>	<b>318</b>	<b>34</b>	<b>34</b>	<b>542</b>	<b>352</b>

## ***SEABECK CREEK (WRIA 15.0400)***

### **Summer Chum 2001**

**Reach** River mile 0.0-0.7  
**Estimate** 0  
**Method** Peak live + dead count  
**Quality rating** Fair  
**Comments** No live or dead fish observed in surveys from 9/12 to 10/10. Surveys by Kitsap Stream Team volunteers.

**Table 1.3.** Seabeck Creek 2001 chum survey data through Oct. 10.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species	Comments	Agency
15 0400	09/12/2001	0.0	0.7	0.7	0	0	0	80	SUPP	FOOT	0 0 0 0	20 30 60	KST
15 0400	09/25/2001	0.0	0.7	0.7	0	0	0	85	SUPP	FOOT	0 0 0 0	20 30 60	KST
15 0400	10/04/2001	0.0	0.7	0.7	0	0	0	90	SUPP	FOOT	4 0 0 0	20 00 00	KST
15 0400	10/10/2001	0.0	0.7	0.7	0	0	0	90	SUPP	FOOT	4 0 0 0	23 34 00	KST

## ***STAVIS CREEK (WRIA 15.0404)***

### **Summer Chum 2001**

**Reach** River mile 0.0-1.0  
**Estimate** 11  
**Method** AUC  
**Quality rating** Good  
**Comments** Frequent surveys from 09/13 to 10/16. Surveys by Kitsap Stream Team volunteers.

**Table 1.4.** Stavis Creek 2001 chum survey data through Oct. 16.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species	Comments	Agency
15 0404	09/13/2001	0.0	1.0	1.0	0	0	0	90	SUPP	FOOT	6 0 0 0	23 33 42	KST
15 0404	09/19/2001	0.0	1.0	1.0	0	0	0	80	SUPP	FOOT	6 0 0 0	23 42 00	KST
15 0404	09/26/2001	0.0	1.0	1.0	2	0	2	60	SUPP	FOOT	0 0 0 0	24 31 60	KST
15 0404	10/05/2001	0.0	1.0	1.0	6	1	7	90	SUPP	FOOT	1 4 6 0	31 24 60	KST
15 0404	10/16/2001	0.0	1.0	1.0	2	1	3	80	SUPP	FOOT	4 0 0 0	33 31 60	KST

Notes:

09/26 - poor visibility in pools and undercuts.

## ANDERSON CREEK (WRIA 15.0412)

### Summer Chum 2001

**Reach** River mile 0.0-1.0  
**Estimate** 0  
**Method** See comments.  
**Quality rating** Fair  
**Comments** Assigned fair rating due to gap between September 7 and October 22 surveys. Assumed escapement was zero due to apparent extirpation of the population, and no fish observed in surveys prior to Oct. 30.

**Table 1.5.** Anderson Creek 2001 chum survey data through Nov. 18.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species	Comments	Agency
15 0412	09/07/2001	0.0	0.1	0.1	0	0	0	95	INDX	FOOT	0 0 0 0	00 20 60	WDFW
15 0412	10/22/2001	0.0	1.0	1.0	0	0	0	70	INDX	FOOT	4 0 0 0	20 48 60	WDFW
15 0412	10/30/2001	0.0	1.0	1.0	0	0	0	90	INDX	FOOT	4 0 0 0	20 48 60	WDFW
15 0412	11/08/2001	0.1	0.0	0.0	0	0	0	90	SPOT	FOOT	0 0 0 0	60 00 00	WDFW
15 0412	11/14/2001	0.1	0.0	0.0	0	0	0	5	SPOT	FOOT	0 0 0 0	28 39 00	WDFW
15 0412	11/18/2001	0.0	1.0	1.0	598	63	661	90	INDX	FOOT	4 8 0 0	20 47 61	WDFW

**Notes:**

09/07 - 2 beaver dams (1 chest-high) observed around RM 0.1.

10/30 - 3 beaver dams, judged impassable.

11/08 - Beaver dam removal in progress - no survey conducted.

## DEWATTO RIVER (WRIA 15.0420)

### Summer Chum 2001

**Reach** River mile 0.3-1.8  
**Estimate** 32  
**Method** AUC - 10 day stream life  
**Quality rating** Good  
**Comments** Chum from 10/12 and 10/22 surveys were classified as last of summer run.

**Table 1.6.** Dewatto River 2001 chum survey data through Oct. 30.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species	Comments	Agency
15 0420	09/07/2001	0.3	1.8	1.5	0	0	0	95	INDX	FOOT	1 3 8 0	20 60 00	WDFW
15 0420	09/17/2001	0.3	1.8	1.5	6	1	7	95	INDX	FOOT	1 4 8 0	20 61 00	WDFW
15 0420	09/26/2001	0.3	1.8	1.5	18	0	18	90	INDX	FOOT	1 4 8 0	20 60 61	WDFW
15 0420	10/04/2001	0.3	1.8	1.5	1	2	3	90	INDX	FOOT	1 3 4 8	20 48 60	WDFW
15 0420	10/12/2001	0.3	1.8	1.5	6	0	6	90	INDX	FOOT	1 3 4 8	20 60 00	WDFW
15 0420	10/22/2001	0.3	1.8	1.5	2	2	4	85	INDX	FOOT	1 3 4 0	20 34 61	WDFW
15 0420	10/29/2001	4.8	5.8	1.0	0	0	0	95	SUPP	FOOT	0 0 0 0	20 48 00	WDFW
15 0420	10/30/2001	0.3	1.8	1.5	171	6	177	90	INDX	FOOT	1 4 8 0	20 61 00	WDFW

Notes:

09/07 - 3 passable beaver dams; 09/17 - 1 beaver dam near RM 1.6, judged impassable.

10/12 - Impassable beaver dam near RM 1.6 was notched.; 10/22 - All chum were between RM 0.3 and 0.5.

## ***TAHUYA RIVER (WRIA 15.0446)***

### **Summer Chum 2001**

**Reach** River mile 0.0-2.6

Estimate 0

Method See comments

Quality rating Good

Comments Escapement estimate was zero due to no fish observed from September 7 to October 4 surveys. Assumed the 3 live fish on October 16 were early fall chum.

**Table 1.7.** Tahuya River 2001 chum survey data through Oct. 25.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species	Comments	Agency
15 0446	09/07/2001	0.0	2.6	2.6	0	0	0	90	INDX	FOOT	4 8 0 0	20 60 00	WDFW
15 0446	09/17/2001	0.0	2.6	2.6	0	0	0	95	INDX	FOOT	4 8 0 0	20 00 00	WDFW
15 0446	09/26/2001	0.0	2.6	2.6	0	0	0	90	INDX	FOOT	1 4 8 0	20 00 00	WDFW
15 0446	10/04/2001	0.0	0.1	0.1	0	0	0	95	INDX	FOOT	1 4 8 0	00 20 48	WDFW
15 0446	10/16/2001	0.0	2.6	2.6	3	0	3	90	INDX	FOOT	1 4 8 0	20 47 61	WDFW
15 0446	10/22/2001	0.0	2.6	2.6	4	0	4	80	INDX	FOOT	1 4 8 0	20 60 61	WDFW
15 0446	10/30/2001	0.0	2.6	2.6	161	3	164	90	INDX	FOOT	4 0 0 0	20 60 61	WDFW

Notes:

10/04 - Beaver dam near RM 0.1, judged impassable; 10/16 - Notched beaver dam near RM 2.0.

## UNION RIVER (WRIA 15.0503)

### Summer Chum 2001

**Reach** River mile 0.3 upstream  
**Estimate** 1426  
**Method** (Trap count) - (broodstock take adjustment)  
**Quality rating** Very Good  
**Comments** Trapped operated by Hood Canal Salmon Enhancement Group and WDFW from August 14 through October 5, to collect broodstock for the supplementation program. A total of 1491 adults were trapped and 65 adults were removed for broodstock. Total return = (1426 natural esc.) + (65 broodstock) = 1491.

**Table 1.8.** 2001 Union River summer chum trapping data.

Date	Trapped		Spawned at trap		Date	Trapped		Spawned at trap	
	Female	Male	Female	Male		Female	Male	Female	Male
8/14/01	2	0			9/10/01	23	23	8	8
8/15/01	0	1			9/11/01	46	46		
8/16/01	1	0			9/12/01	50	50		
8/17/01	2	1			9/13/01	41	41	4	5
8/18/01	8	12			9/14/01	44	44		
8/19/01	6	9			9/15/01	27	27		
8/20/01	6	10			9/16/01	29	29		
8/21/01	8	17			9/17/01	16	16		
8/22/01	24	37			9/18/01	16	16	4	5
8/23/01	24	19			9/19/01	20	11		
8/24/01	30	16			9/20/01	25	25		
8/25/01	14	15			9/21/01	22	22		
8/26/01	12	7			9/22/01	13	13		
8/27/01	13	8			9/23/01	17	17		
8/28/01	3	4			9/24/01	19	19		
8/29/01	6	3			9/25/01	9	9	3	3
8/30/01	10	15			9/26/01	15	15		
8/31/01	7	9			9/27/01	6	6		
9/1/01	16	14			9/28/01	5	5		
9/2/01	11	8			9/29/01	9	9		
9/3/01	7	9			9/30/01	3	3		
9/4/01	12	14	2	2	10/1/01	10	10		
9/5/01	13	15			10/2/01	7	2		
9/6/01	13	16	11	10	10/3/01	4	9		
9/7/01	13	7			10/4/01	12	4		
9/8/01	22	13			10/5/01	4	5		
9/9/01	19	17			<b>Total</b>	<b>794</b>	<b>697</b>	<b>32</b>	<b>33</b>

## SKOKOMISH RIVER (WRIA 16.0012)

### Summer Chum 2001

**Reach** River mile 5.3 - 9.0  
**Estimate** 3  
**Method** 08/30 live count + 09/06 live count  
**Quality rating** Fair  
**Comments** 3 fish were seen during index surveys for chinook and summer chum. Added live counts since fish seen on 09/06 was downstream of fish seen on 08/30.

**Table 1.9.** Skokomish River 2001 chum survey data through 10/22.

WRIA	Date	Lower RM	Upper RM	Length	Live +			Type			Other Species	Comments	Agency
					Live	Dead	Dead	Vis	Survey	Method			
16 0001	08/30/2001	5.3	6.3	1.0	0	0	0	85	INDX	RAFT	1 3 4 0	00 23 33	WDFW
<b>16 0001</b>	<b>08/30/2001</b>	<b>6.3</b>	<b>8.0</b>	<b>1.7</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>85</b>	<b>INDX</b>	<b>RAFT</b>	<b>1 0 0 0</b>	<b>00 23 33</b>	<b>WDFW</b>
16 0001	08/30/2001	8.0	9.0	1.0	0	0	0	85	INDX	RAFT	1 0 0 0	00 23 33	WDFW
<b>16 0001</b>	<b>09/06/2001</b>	<b>5.3</b>	<b>6.3</b>	<b>1.0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>80</b>	<b>INDX</b>	<b>RAFT</b>	<b>1 3 4 0</b>	<b>00 23 33</b>	<b>WDFW</b>
16 0001	09/06/2001	6.3	8.0	1.7	0	0	0	90	INDX	RAFT	1 3 0 0	00 23 33	WDFW
16 0001	09/06/2001	8.0	9.0	1.0	0	0	0	90	INDX	RAFT	1 3 0 0	00 23 33	WDFW
16 0001	09/18/2001	5.3	6.3	1.0	0	0	0	95	INDX	RAFT	1 3 4 0	20 00 00	WDFW
16 0001	09/18/2001	6.3	8.0	1.7	0	0	0	95	INDX	RAFT	1 3 4 0	00 20 33	WDFW
16 0001	09/18/2001	8.0	9.0	1.0	0	0	0	95	INDX	RAFT	1 3 0 0	00 20 33	WDFW
16 0001	09/28/2001	5.3	6.3	1.0	0	0	0	90	INDX	FOOT	1 4 0 0	20 33 00	WDFW
16 0001	09/28/2001	6.3	8.0	1.7	0	0	0	90	INDX	RAFT	1 0 0 0	20 33 00	WDFW
16 0001	09/28/2001	8.0	9.0	1.0	0	0	0	90	INDX	RAFT	1 3 0 0	10 20 33	WDFW
16 0001	10/05/2001	5.3	6.3	1.0	0	0	0	95	INDX	RAFT	1 4 0 0	10 20 33	WDFW
16 0001	10/05/2001	6.3	8.0	1.7	0	0	0	95	INDX	RAFT	1 0 0 0	10 20 33	WDFW
16 0001	10/05/2001	8.0	9.0	1.0	0	0	0	95	INDX	RAFT	1 0 0 0	10 20 33	WDFW
16 0001	10/12/2001	5.3	6.3	1.0	0	0	0	90	INDX	RAFT	1 4 0 0	00 20 33	WDFW
16 0001	10/12/2001	6.3	8.0	1.7	0	0	0	90	INDX	RAFT	1 0 0 0	00 20 33	WDFW
16 0001	10/12/2001	8.0	9.0	1.0	0	0	0	90	INDX	RAFT	1 0 0 0	00 20 33	WDFW
16 0001	10/22/2001	5.3	6.3	1.0	0	0	0	85	INDX	RAFT	0 0 0 0	00 21 34	WDFW
16 0001	10/22/2001	6.3	8.0	1.7	0	0	0	85	INDX	RAFT	1 0 0 0	00 21 34	WDFW
16 0001	10/22/2001	8.0	9.0	1.0	0	0	0	85	INDX	RAFT	1 0 0 0	00 21 34	WDFW

## FINCH CREEK (WRIA 16.0222)

### Summer Chum 2001

**Reach** River mile 0.0  
**Estimate** 0  
**Method** Rack count  
**Quality rating** Good  
**Comments** All chum trapped at Hoodspport Hatchery before 10/15 are returned to stream, to protect potential summer chum. In 2001, 12 chum were trapped on 10/10, but it is unknown if they were summer chum. Due to late arrival timing and apparent extirpation of the population, assumed these were early fall fish.

## LILLIWAUP CREEK (WRIA 16.0230)

### Summer Chum 2001

**Reach** River mile 0.0-0.7  
**Estimate** 32  
**Method** Upstream/downstream spawner counts  
**Quality rating** Very Good  
**Comments** Trap operated by LLTK (Long Live the Kings) from September 3 through October 12. Total return = 92. Sixty fish were used for broodstock for the supplementation program, including 20 mortalities (all males). High number of male mortalities was due to skewed sex ratio - males were retained for broodstock, but lack of female return precluded spawning all of the males. Total escapement upstream of trap = 14; total escapement downstream of trap = 18 (pers. comm., R. Endicott, LLTK)

**Table 1.10.** 2001 Lilliwaup Creek summer chum trapping data.

Date	Number trapped		Snagged for broodstock		Date	Number trapped		Snagged for broodstock	
	Female	Male	Female	Male		Female	Male	Female	Male
03-Sep-01					23-Sep-01	1	5		
04-Sep-01					24-Sep-01		1		
05-Sep-01					25-Sep-01		3		
06-Sep-01		2			26-Sep-01		7	2	
07-Sep-01	3	2			27-Sep-01		1		
08-Sep-01	4	4			28-Sep-01				6
09-Sep-01	1	2			29-Sep-01				5
10-Sep-01	2	3			30-Sep-01		2		
11-Sep-01		1			01-Oct-01				3
12-Sep-01	4	4			02-Oct-01				3
13-Sep-01		2			03-Oct-01				
14-Sep-01	1	1			04-Oct-01				
15-Sep-01					05-Oct-01				
16-Sep-01		2			06-Oct-01				
17-Sep-01		1			07-Oct-01				
18-Sep-01		1			08-Oct-01				
19-Sep-01					09-Oct-01				
20-Sep-01	1				10-Oct-01				
21-Sep-01		3	1		11-Oct-01				
22-Sep-01	1	2			12-Oct-01				
					<b>Total</b>	<b>18</b>	<b>49</b>	<b>3</b>	<b>17</b>

## HAMMA HAMMA RIVER (WRIA 16.0251)

### Summer Chum 2001

**Reach** River mile 0.3-1.8  
**Estimate** 1162  
**Method** AUC - 10 day stream life (w/ broodstock take adjustment)  
**Quality rating** Good  
**Comments** 54 broodstock were collected for supplementation program.  
 Adjusted escapement = [(11888 FD) - (54 broodstock x 5 days assumed average residence before removal)] / (10 day stream life) = 1162  
 Total return = (1162 natural esc.) + (54 broodstock) = 1216

Table 1.11. Hamma Hamma River 2001 chum survey data through Nov. 26.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species	Comments	Agency
16 0251	08/27/2001	0.3	1.8	1.5	24	0	24	80	INDX	FOOT	3 0 0 0	21 60 00	WDFW
16 0251	09/06/2001	0.3	1.8	1.5	261	3	264	95	INDX	RAFT	1 3 4 0	20 00 00	WDFW
16 0251	09/14/2001	0.3	1.8	1.5	303	27	330	90	INDX	RAFT	1 3 4 0	20 00 00	WDFW
16 0251	09/24/2001	0.3	1.8	1.5	441	195	636	90	INDX	RAFT	1 3 4 0	20 60 00	WDFW
16 0251	10/03/2001	0.3	1.8	1.5	133	56	189	90	INDX	FOOT	1 3 4 0	20 60 61	WDFW
16 0251	10/12/2001	0.3	1.8	1.5	11	32	43	90	INDX	FOOT	1 3 4 0	20 61 00	WDFW
16 0251	10/22/2001	0.3	1.8	1.5	25	7	32	90	INDX	FOOT	1 3 4 0	20 34 61	WDFW
16 0251	11/14/2001	0.0	0.0	0.0	0	0	0	40	SPOT	FOOT	0 0 0 0	28 39 00	WDFW
16 0251	11/19/2001	0.0	0.0	0.0	0	0	0	30	SPOT	FOOT	0 0 0 0	28 39 00	WDFW
16 0251	11/26/2001	1.0	0.0	0.0	0	0	0	50	SPOT	FOOT	0 0 0 0	27 39 00	WDFW

Notes:  
08/27 - 2 of 24 chum observed were on a redd.

## JOHN CREEK (WRIA 16.0253)

### Summer Chum 2001

**Reach** River mile 0.0-1.6  
**Estimate** 11  
**Method** Peak live + dead counts  
**Quality rating** Fair  
**Comments** Low live numbers throughout summer run give AUC estimate of 4 fish. 10 dead on October 3, and 1 live fish on October 12 were assumed to be summer run due to live counts of zero before first appearance of fall chum on November 6.

**Table 1.12.** John Creek 2001 chum survey data through Nov. 6 .

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species	Comments	Agency
16 0253	08/27/2001	0.0	0.1	0.1	1	0	1	99	INDX	FOOT	0 0 0 0	20 60 00	WDFW
16 0253	09/06/2001	0.0	0.4	0.4	0	0	0	95	INDX	FOOT	1 3 0 0	00 20 60	WDFW
16 0253	09/14/2001	0.0	0.4	0.4	2	0	2	95	INDX	FOOT	1 3 0 0	00 20 60	WDFW
16 0253	09/24/2001	0.0	1.0	1.0	0	5	5	95	INDX	FOOT	3 0 0 0	00 20 60	WDFW
<b>16 0253</b>	<b>10/03/2001</b>	<b>0.0</b>	<b>0.9</b>	<b>0.9</b>	<b>0</b>	<b>10</b>	<b>10</b>	<b>95</b>	<b>INDX</b>	<b>FOOT</b>	<b>1 3 0 0</b>	<b>00 20 60</b>	<b>WDFW</b>
<b>16 0253</b>	<b>10/12/2001</b>	<b>0.0</b>	<b>1.6</b>	<b>1.6</b>	<b>1</b>	<b>7</b>	<b>8</b>	<b>95</b>	<b>INDX</b>	<b>FOOT</b>	<b>1 3 0 0</b>	<b>20 60 61</b>	<b>WDFW</b>
16 0253	10/22/2001	0.0	1.6	1.6	0	2	2	95	INDX	FOOT	1 3 0 0	20 61 00	WDFW
16 0253	11/06/2001	0.0	1.6	1.6	39	42	81	95	INDX	FOOT	0 0 0 0	20 61 00	WDFW

Notes: 08/27 - 1 chum on a redd just upstream from lower bridge.

## **FULTON CREEK (WRIA 16.0332)**

### **Summer Chum 2002**

**Reach** River mile **0.0-0.8**  
**Estimate** 7  
**Method** Peak live + dead  
**Quality rating** Poor  
**Comments** No surveys between 9/21 and 10/17, making it impossible to discern peak timing or peak magnitude for the escapement curve.

**Table 1.13.** Fulton Creek 2001 chum survey data through Nov. 6 .

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species	Comments	Agency
16 0332	09/14/2001	0.0	0.8	0.8	3	2	5	95	SUPP	FOOT	0 0 0 0	20 60 00	HCCC
16 0332	09/21/2001	0.0	0.8	0.8	5	2	7	95	SUPP	FOOT	3 0 0 0	20 60 00	HCCC
16 0332	10/17/2001	0.0	0.8	0.8	0	0	0	95	INDX	FOOT	4 0 0 0	20 00 00	WDFW
16 0332	11/07/2001	0.0	0.8	0.8	28	6	34	90	INDX	FOOT	4 8 0 0	20 61 00	WDFW

Notes: 9/14 and 9/21 surveys by Hood Canal Coordinating Council staff

## ***DUCKABUSH RIVER (WRIA 16.0351)***

### **Summer Chum 2001**

**Reach** River mile 0.0-2.3  
**Estimate** 942  
**Method** AUC - 10 day stream life  
**Quality rating** Fair/Good  
**Comments** There were no surveys to define the starting point or ascending side of the curve. The first survey on September 6 yielded the peak live count. This is well before typical peak of run, and there were only 3 dead on peak survey, so it is unlikely that the actual peak was much earlier.

**Table 1.14.** Duckabush River 2001 chum survey data through Oct. 19.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species				Comments			Agency
16 0351	09/06/2001	0.0	2.3	2.3	309	3	312	90	INDX	FOOT	3	4	0	0	20	60	61	WDFW
16 0351	09/13/2001	0.0	2.3	2.3	282	33	315	95	INDX	FOOT	3	0	0	0	20	60	61	WDFW
16 0351	09/21/2001	0.0	2.3	2.3	247	120	367	90	INDX	FOOT	1	3	4	0	20	60	61	WDFW
16 0351	10/03/2001	0.0	2.3	2.3	57	0	57	95	INDX	FOOT	1	3	4	0	20	60	00	WDFW
16 0351	10/03/2001	2.3	2.6	0.3	0	0	0	95	SUPP	FOOT	1	3	4	0	20	00	00	WDFW
16 0351	10/11/2001	0.0	2.3	2.3	13	48	61	90	INDX	FOOT	1	3	4	0	20	61	00	WDFW
16 0351	10/11/2001	2.3	2.6	0.3	1	3	4	95	SUPP	FOOT	1	3	4	0	20	00	00	WDFW
16 0351	10/19/2001	0.0	2.3	2.3	14	22	36	95	INDX	FOOT	1	3	4	0	20	61	00	WDFW

## ***DOSEWALLIPS RIVER (WRIA 16.0442)***

### **Summer Chum 2001**

**Reach** River mile 0.1-2.3  
**Estimate** 990  
**Method** AUC - 10 day stream life  
**Quality rating** Good  
**Comments** Starting point of curve not defined, remainder of curve defined relatively well. Fish on 10/29 were assumed to be the first fall chum.

**Table 1.15.** Dosewallips River 2001 chum survey data through Oct. 29.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species				Comments			Agency
16 0442	09/06/2001	0.0	2.3	2.3	116	1	117	95	INDX	FOOT	3	4	0	0	20	61	00	WDFW
16 0442	09/13/2001	0.0	2.3	2.3	159	15	174	95	INDX	FOOT	1	3	0	0	20	60	61	WDFW
16 0442	09/13/2001	3.6	6.7	3.1	0	0	0	95	SUPP	FOOT	1	3	0	0	20	00	00	WDFW
16 0442	09/21/2001	0.0	2.3	2.3	430	41	471	90	INDX	FOOT	1	3	4	0	20	60	61	WDFW
16 0442	09/21/2001	3.6	6.7	3.1	0	0	0	90	SUPP	FOOT	3	0	0	0	20	00	00	WDFW
16 0442	10/02/2001	0.0	2.3	2.3	217	0	217	90	INDX	FOOT	1	3	4	0	20	60	61	WDFW
16 0442	10/02/2001	3.6	6.7	3.1	0	0	0	90	SUPP	FOOT	1	3	0	0	20	00	00	WDFW
16 0442	10/02/2001	7.0	11.0	4.0	0	0	0	90	SUPP	FOOT	1	3	0	0	20	00	00	WDFW
16 0442	10/11/2001	0.0	2.3	2.3	13	67	80	90	INDX	FOOT	1	3	4	0	20	60	61	WDFW
16 0442	10/11/2001	3.6	6.7	3.1	2	1	3	90	SUPP	FOOT	3	4	0	0	20	60	61	WDFW
16 0442	10/19/2001	0.0	2.3	2.3	5	55	60	95	INDX	FOOT	1	3	4	0	20	33	61	WDFW
16 0442	10/19/2001	3.6	6.7	3.1	0	2	2	90	SUPP	FOOT	1	4	0	0	20	60	61	WDFW
16 0442	10/29/2001	0.0	2.3	2.3	4	2	6	90	INDX	FOOT	4	0	0	0	20	61	00	WDFW

Notes:  
10/19 - 1 active redd just below highway bridge.

## ***BIG QUILCENE RIVER (WRIA 17.0012)***

### **Summer Chum 2001**

**Reach** River mile 0.0-2.7

Estimate 5868

Method AUC - 10 day stream life

Quality rating Very Good

Comments Entire curve well-defined.

Total return = 6185. US Fish and Wildlife Service collected 317 broodstock from beach seine sets in Quilcene Bay (of these, 11 died during capture).

**Table 1.16.** Big Quilcene River 2001 chum survey data through Nov. 13.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species				Comments			Agency
17 0012	08/15/2001	0.0	1.4	1.4	27	0	27	95	INDX	SNKL	3	0	0	0	20	60	00	USFWS
17 0012	08/24/2001	0.0	2.7	2.7	132	4	136	80	INDX	FOOT	3	5	0	0	23	60	00	WDFW
17 0012	08/31/2001	0.0	2.7	2.7	689		689	90	INDX	FOOT	3	0	0	0	20	60	00	WDFW
17 0012	09/07/2001	0.0	2.7	2.7	1613		1613	90	INDX	FOOT	3	0	0	0	20	60	00	WDFW
17 0012	09/14/2001	0.0	2.7	2.7	1822		1822	95	INDX	FOOT	3	0	0	0	20	60	00	WDFW
17 0012	09/21/2001	0.0	2.7	2.7	1569		1569	95	INDX	FOOT	3	0	0	0	20	60	00	WDFW
17 0012	09/28/2001	0.0	2.7	2.7	1476		1476	95	INDX	FOOT	3	0	0	0	20	60	00	WDFW
17 0012	10/08/2001	0.0	2.7	2.7	351		351	95	INDX	FOOT	3	0	0	0	20	60	00	WDFW
17 0012	10/17/2001	0.0	2.7	2.7	33		33	95	INDX	FOOT	3	0	0	0	20	60	00	WDFW
17 0012	11/13/2001	0.0	2.7	2.7	329	0	329	85	INDX	FOOT	4	0	0	0	21	60	00	WDFW

Notes:  
08/15 - Snorkel survey conducted by USFWS; 09/07 - Approx. 1/3 of chum on redds.  
09/28 - Many new fish in river; 10/08 - Still some new fish in river.

## ***LITTLE QUILCENE RIVER (WRIA 17.0076)***

### **Summer Chum 2001**

**Reach** River mile 0.0-1.8  
 Estimate 199  
 Method AUC - 10 day stream life  
 Quality rating Very good  
 Comments Entire curve well-defined.

**Table 1.17.** Little Quilcene River 2001 chum survey data through Oct. 8.

WRIA	Date	Lower RM	Upper RM	Length	Live +		Vis	Type Survey	Method	Other Species				Comments			Agency	
					Live	Dead				Dead								
17 0076	08/24/2001	0.0	0.8	0.8	6	0	6	90	INDX	FOOT	0	0	0	0	20	60	00	WDFW
17 0076	08/31/2001	0.0	0.8	0.8	13	0	13	95	INDX	FOOT	0	0	0	0	20	60	00	WDFW
17 0076	09/07/2001	0.0	1.8	1.8	26	0	26	90	INDX	FOOT	0	0	0	0	20	60	00	WDFW
17 0076	09/14/2001	0.0	1.8	1.8	81	13	94	95	INDX	FOOT	0	0	0	0	20	60	00	WDFW
17 0076	09/21/2001	0.0	1.8	1.8	66	31	94	95	INDX	FOOT	3	0	0	0	20	60	00	WDFW
17 0076	09/29/2001	0.0	0.8	0.8	45	95	140	95	INDX	FOOT	3	4	0	0	20	60	00	WDFW
17 0076	10/08/2001	0.0	0.8	0.8	18	128	146	95	INDX	FOOT	0	0	0	0	20	00	00	WDFW

Notes:

08/24 - 2 fish on 2 redds; 09/07 - 12 redds in lower section (RM 0.0-0.8), 2 in upper section (.8-1.8)  
 09/14 - 29 new redds in lower section

## ***CHIMACUM CREEK (WRIA 17.0203)***

### **Summer Chum 2001**

**Reach** River mile 0.0-1.0  
 Estimate 903  
 Method AUC - 10 day stream life  
 Quality rating Very good  
 Comments Entire curve well-defined. Surveys conducted by WOS and NOSC.

**Table 1.18.** Chimacum Creek 2001 chum survey data through Oct. 18.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species				Comments			Agency
17 0203	08/30/2001	0.0	0.4	0.4	0	1	1	90	INDX	FOOT	0	0	0	0	38	00	00	WOS
17 0203	08/30/2001	0.4	1.0	0.6	2	0	2	85	INDX	FOOT	0	0	0	0	21	33	00	WOS
17 0203	09/06/2001	0.0	0.4	0.4	33	0	33	90	INDX	FOOT	0	0	0	0	25	38	00	WOS
17 0203	09/06/2001	0.4	1.0	0.6	44	0	44	95	INDX	FOOT	0	0	0	0	11	60	61	WOS
17 0203	09/13/2001	0.0	0.4	0.4	81	6	87	90	INDX	FOOT	0	0	0	0	23	15	00	WOS
17 0203	09/13/2001	0.4	1.0	0.6	141	18	159	90	INDX	FOOT	0	0	0	0	00	00	00	WOS
17 0203	09/20/2001	0.0	0.4	0.4	78	40	118	90	INDX	FOOT	0	0	0	0	38	00	00	WOS
17 0203	09/20/2001	0.4	1.0	0.6	195	106	301	90	INDX	FOOT	0	0	0	0	38	00	00	WOS
17 0203	09/27/2001	0.0	0.4	0.4	86	77	163	90	INDX	FOOT	0	0	0	0	24	33	00	WOS
17 0203	09/27/2001	0.4	1.0	0.6	180	169	349	95	INDX	FOOT	0	0	0	0	00	00	00	WOS
17 0203	10/04/2001	0.0	0.4	0.4	54	80	134	90	INDX	FOOT	3	0	0	0	00	00	00	WOS
17 0203	10/04/2001	0.4	1.0	0.6	162	135	297	90	INDX	FOOT	0	0	0	0	20	00	00	WOS
17 0203	10/11/2001	0.0	0.4	0.4	47	123	170	90	INDX	FOOT	4	0	0	0	00	00	00	WOS
17 0203	10/11/2001	0.4	1.0	0.6	62	172	234	90	INDX	FOOT	4	0	0	0	00	00	00	WOS
17 0203	10/18/2001	0.0	0.4	0.4	30	88	118	90	INDX	FOOT	4	0	0	0	00	00	00	WOS
17 0203	10/18/2001	0.4	1.0	0.6	38	132	170	85	INDX	FOOT	4	0	0	0	00	00	00	WOS

Notes:

Surveys conducted by Wild Olympic Salmon and North Olympic Salmon Coalition.

## ***SNOW CREEK (WRIA 17.0219)***

### **Summer Chum 2001**

**Reach** River mile 0.0 - 0.8  
**Estimate** 154  
**Method** AUC - 10 day stream life  
**Quality rating** Very Good  
**Comments** Entire curve well-defined. No summer chum collected in WDFW trap at RM 0.8.

**Table 1.19.** Snow Creek 2001 chum survey data through Oct. 24.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Type Survey	Method	Other Species				Comments			Agency
17 0219	09/14/2001	0.1	0.8	0.7	0	0	0	95	INDX	FOOT	0	0	0	0	20	60	00	WDFW
17 0219	09/24/2001	0.2	0.8	0.6	32	12	44	90	INDX	FOOT	0	0	0	0	00	00	00	WDFW
17 0219	09/28/2001	0.2	0.8	0.6	75	18	93	85	INDX	FOOT	0	0	0	0	20	60	00	WDFW
17 0219	10/01/2001	0.0	0.8	0.8	80	20	100	85	INDX	FOOT	0	0	0	0	20	00	00	WDFW
17 0219	10/09/2001	0.2	0.8	0.6	33	69	102	95	INDX	FOOT	0	0	0	0	20	00	00	WDFW
17 0219	10/17/2001	0.0	0.8	0.8	28	66	94	95	INDX	FOOT	0	0	0	0	20	60	00	WDFW
17 0219	10/24/2001	0.0	0.8	0.8	7	0	7	95	INDX	FOOT	0	0	0	0	20	00	00	WDFW

Notes:

10/17 - All chum on redds.

## SALMON CREEK (WRIA 17.0245)

### Summer Chum 2001

<b>Reach</b>	<b>River mile 0.0 upstream</b>
Estimate	2,484
Method	(Trap count) - (broodstock take adjustment) + (downstream redd count adjustment)
Quality rating	Very good
Comments	Trap was operated continuously at RM 0.3 by WDFW from August 23 through October 26 as part of a supplementation program initiated with brood year 1992. 2,413 adults were passed upstream. 154 adults were removed for broodstock. 32 redds were counted downstream of trap; assuming 1 female per redd and using sex ratio from trap of 1.2178 males/female, an estimated 71 fish spawned downstream. Total return = (2,413 + 71 natural esc.) + (154 broodstock) = 2,638 fish.

**Table 1.20.** 2001 Salmon Creek summer chum trapping and downstream redd data.

Date	Passed Upstream		Spawned at Trap		Redds Downstream	Date	Passed Upstream		Spawned at Trap		Redds Downstream
	Female	Male	Female	Male			Female	Male	Female	Male	
08/23/01	0	1				09/25/01	32	38			
08/24/01	0	1				09/26/01	21	30			
08/25/01	1	1				09/27/01	0	0			
08/26/01	1	1				09/28/01	38	30	8	8	14
08/27/01	1	2				09/29/01	23	28			
08/28/01	1	1				09/30/01	0	0			
08/29/01	0	0				10/01/01	107	87	8	10	
08/30/01	0	0				10/02/01	40	23			
08/31/01	1	1				10/03/01	35	20			
09/02/01	4	2				10/04/01	29	19			
09/03/01	7	9				10/05/01	16	15			
09/04/01	0	3				10/06/01	1	11			8
09/05/01	8	9				10/08/01	2	16			
09/06/01	7	10				10/09/01	1	1			
09/07/01	12	28				10/10/01	1	9			
09/08/01	13	16				10/11/01	0	3			
09/09/01	15	10				10/12/01	1	3			
09/10/01	25	32				10/13/01	1	6			
09/11/01	36	78				10/14/01	37	22			
09/12/01	6	13				10/15/01	12	8			
09/13/01	39	52	12	12		10/16/01	25	23			
09/14/01	40	50				10/17/01	10	12			
09/15/01	30	71				10/18/01	3	3			
09/16/01	0	0				10/19/01	10	4			
09/17/01	59	69	24	24		10/20/01	17	6			
09/18/01	39	51			10	10/21/01	5	2			
09/19/01	0	0				10/22/01	1	1			
09/20/01	95	121	12	12		10/23/01	0	0			
09/21/01	88	161				10/24/01					
09/22/01	63	67				10/25/01	1	2			
09/23/01	11	17				10/26/01	2	0			
09/24/01	15	26	12	12		<b>Total</b>	<b>1088</b>	<b>1325</b>	<b>76</b>	<b>78</b>	<b>32</b>

## ***JIMMYCOMELATELY CREEK (WRIA 17.0285)***

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### **Summer Chum 2001**

<b>Reach</b>	<b>River mile 0.0 upstream</b>
Estimate	192
Method	(Trap count) - (broodstock take adjustment) + (downstream redd count adjustment)
Quality rating	Very good
Comments	Trap operated continuously by WDFW and North Olympic Salmon Coalition at RM 0.1 from August 29 through October 17, as part of a supplementation program. 172 fish passed upstream. Downstream spawning escapement = 20 (estimated from redd count adjusted for spawn-outs entering trap). 68 fish removed for broodstock (includes 4 mortalities). Additional 24 fish downstream pre-escapement loss due to predation. Total return = (192 natural esc) + (68 broodstock) + (24 pre-escapement loss) = 284.

**Table 1.21.** 2001 chum trapping totals from Jimmycomelately Creek.

Date	Adults trapped		Spawned at trap		Passed upstream		Downstream redds	Pre-escapement loss		Notes
	Fem	Male	Fem	Male	Fem	Male		Fem	Male	
29-Aug-01					1					Trap installed; 1 F already upstream
30-Aug-01										
31-Aug-01		1								Died in tube 9/10
01-Sep-01										
02-Sep-01								1		
03-Sep-01										
04-Sep-01										
05-Sep-01	4	6					2		2	
06-Sep-01	1	1						1		
07-Sep-01	3	3								
08-Sep-01	5	6					1			1 M dead in tube
09-Sep-01	7	12						1		
10-Sep-01	6	5	17	17	9	12	1			4 partial spawnouts in broodstock
11-Sep-01	3	2			1	2		1	1	
12-Sep-01	6	6			9	8	3			
13-Sep-01	7	4			7	4	1	2	2	
14-Sep-01	8	8			8	8				
15-Sep-01	9	4			4				1	2 spawnouts
16-Sep-01	7	4			3		2			2 spawnouts, 1 partial spawnout
17-Sep-01		1	7	7	2	2				1 partial spawnout in broodstock
18-Sep-01	4	3								
19-Sep-01	1	4					2			15 live, 49 dead, 26 redds above trap
20-Sep-01	3						2		1	
21-Sep-01	4	4			4	3	2			
22-Sep-01	9	2			8	1	2			5 spawnouts
23-Sep-01	8	10			5	7	2			1 M dead in tube, 4 spawnout
24-Sep-01	8	4	8	8	13	5				1 M dead in tube, 5 spawnout (1 brdstk)
25-Sep-01	7	2			7	2				1 spawnout
26-Sep-01	7	4			7	4				2 spawnout
27-Sep-01	7	4			7	4				
28-Sep-01	2	3			2			1		2 spawnout
29-Sep-01		2						1		
30-Sep-01	2							1		
01-Oct-01					2	5		1	1	
02-Oct-01	1									
03-Oct-01	2				3			3		
04-Oct-01								1		
05-Oct-01										
06-Oct-01	2				2					
07-Oct-01										
08-Oct-01	1				1			2		
29-Oct-01										Trap removed
<b>Totals</b>	<b>134</b>	<b>105</b>	<b>32</b>	<b>32</b>	<b>105</b>	<b>67</b>	<b>20</b>	<b>16</b>	<b>8</b>	

## DUNGENESS RIVER (WRIA 18.0018)

### Summer Chum 2001

**Reach** River mile 0.0 upstream  
**Estimate** 10  
**Method** Rack count  
**Quality rating** Fair  
**Comments** Regular surveys were conducted from late July through early October. Data presented here are summaries of those multi-day surveys. One live and one dead chum were observed on a survey October 9, for and estimate of 2 based on spawning ground surveys.

A rack was operated in the lower Dungeness in 2001 for capture of pink salmon. Hatchery staff reported capturing and releasing 10 chum between August 14 and September 18. This is likely an underestimate, as the rack was operated as a total barrier to upstream fish migration for an estimated 60% of the time in operation, and was not operated for the entire summer-run time period. In addition, chum could have spawned downstream, without passing the weir.

**Table 1.22.** Dungeness River 2001 survey data through Nov 8.

WRIA	Date	Lower RM	Upper RM	Length	Live +			Type			Other Species				Comments			Agency
					Live	Dead	Dead	Vis	Survey	Method								
18 0018	07/23/2001	0.0	15.8	15.8	0	0	0	75	INDEX	FOOT	3	1	0	0	20	00	00	WDFW
18 0018	07/31/2001	0.0	15.8	15.8	0	0	0	75	INDEX	FOOT	3	1	0	0	20	00	00	WDFW
18 0018	08/06/2001	0	18.7	18.7	0	0	0	85	INDEX	FOOT	3	1	0	0	20	00	00	WDFW
18 0018	08/13/2001	0	18.7	18.7	0	0	0	80	INDEX	FOOT	3	1	0	0	20	00	00	WDFW
18 0018	08/27/2001	0	18.7	18.7	0	0	0	75	INDEX	FOOT	3	1	0	0	20	21	24	WDFW
18 0018	09/04/2001	9.2	18.7	9.5	0	0	0	80	INDEX	FOOT	3	1	0	0	20	00	00	WDFW
18 0018	09/10/2001	0	18.7	18.7	0	0	0	80	INDEX	FOOT	3	1	0	0	20	60	00	WDFW
18 0018	09/17/2001	0	9.2	9.2	0	0	0	80	INDEX	FOOT	3	1	0	0	20	60	00	WDFW
18 0018	09/17/2001	10.8	18.7	7.9	0	0	0	80	INDEX	FOOT	3	1	0	0	20	00	00	WDFW
18 0018	09/24/2001	6.4	10.8	4.4	0	0	0	85	INDEX	FOOT	3	1	0	0	20	00	00	WDFW
18 0018	09/28/2001	0	3.3	3.3	0	0	0	80	INDEX	FOOT	3	1	0	0	20	00	00	WDFW
18 0018	10/02/2001	3.3	10.8	7.5	0	0	0	85	INDEX	FOOT	3	1	0	0	20	00	00	WDFW
<b>18 0018</b>	<b>10/09/2001</b>	<b>0.0</b>	<b>3.3</b>	<b>3.3</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>85</b>	<b>INDEX</b>	<b>FOOT</b>	<b>1</b>	<b>3</b>	<b>4</b>	<b>0</b>	<b>20</b>	<b>00</b>	<b>00</b>	<b>WDFW</b>
18 0018	10/17/2001	0.0	3.3	3.3	0	0	0	85	INDEX	FOOT	3	0	0	0	20	00	00	WDFW
18 0018	10/31/2001	0.0	0.0	0.0	0	0	0	10	SPOT	FOOT	0	0	0	0	28	60	00	WDFW
18 0018	11/08/2001	0.9	3.3	2.4	140	30	170	70	SUPP	FOOT	4	0	0	0	00	00	00	WDFW

Notes:  
 07/23/2001 - Multi-day chinook/pink survey conducted from 7/23 to 7/27; no chum observed.  
 07/31/2001 - Multi-day chinook/pink survey conducted from 7/31 to 8/03; no chum observed.  
 08/06/2001 - Multi-day chinook/pink survey conducted from 8/06 to 8/10; no chum observed.  
 08/13/2001 - Multi-day chinook/pink survey conducted from 8/13 to 8/17; no chum observed.  
 08/20/2001 - Lower river not surveyable  
 08/27/2001 - Multi-day chinook/pink survey conducted from 8/27 to 8/31; no chum observed.  
 09/04/2001 - Multi-day chinook/pink survey conducted from 9/04 to 9/07; no chum observed. Lower river not surveyed.  
 09/10/2001 - Multi-day chinook/pink survey conducted from 9/10 to 9/17; no chum observed.  
 09/17/2001 - Multi-day chinook/pink survey conducted from 9/17 to 9/21; no chum observed. RM 9.2 to 10.8 not surveyed.  
 10/02/2001 - Multi-day chinook/pink survey conducted from 10/02 to 10/09; 2 chum observed in 0.0 to 3.3 reach on 10/09.

# 2002 SUMMER CHUM NATURAL SPAWNING ESCAPEMENT SUMMARY

## LITTLE ANDERSON CREEK (WRIA 15.0377)

### Summer Chum 2002

**Reach** River mile 0.0-0.4  
**Estimate** 0  
**Method** No fish observed  
**Quality rating** Fair  
**Comments** Surveys conducted by Kitsap Stream Team (KST). No chum observed on surveys from 09/30 to 10/30. Rated fair due to lack of surveys in September.

**Table 1.23.** Little Anderson Creek 2002 chum survey data through Oct. 30.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
15 0377	09/30/02	0	0.4	0.4	0	0	0			GOOD		INDEX	FOOT	KST
15 0377	10/07/02	0	0.4	0.4	0	0	0			GOOD		INDEX	FOOT	KST
15 0377	10/15/02	0	0.4	0.4	0	0	0			GOOD		INDEX	FOOT	KST
15 0377	10/21/02	0	0.4	0.4	0	0	0			GOOD		INDEX	FOOT	KST
15 0377	10/30/02	0	0.4	0.4	0	0	0			GOOD		INDEX	FOOT	KST

Notes:  
 Log jam may have limited access to chum.

## BIG BEEF CREEK (WRIA 15.0389)

### Summer Chum 2002

**Reach** River mile 0.0 upstream  
**Estimate** 677  
**Method** Trap count - (broodstock take adjustment) + (downstream spawner adjustment)  
**Quality rating** Very good  
**Comments** Trap operated from September 9 through the fall chum run; October 15 set as end of summer chum run. 65 fish were used for broodstock (including 3 mortalities). 109 fish counted dead downstream or entered trap after spawning.  
 Total return = (568 + 109 natural esc.) + (65 broodstock) = 742.

**Table 1.24.** 2002 Big Beef Creek trap and downstream chum data through Oct. 15.

Date	Released upstream of trap		Downstream dead adults + spawn-outs entering trap	Retained for broodstock		Total adults
	Male	Female		Male	Female	
09-Sep-02	2	1				3
10-Sep-02	3	3				6
11-Sep-02	6	0		6	1	13
12-Sep-02	16	6			5	27
13-Sep-02	1	2		1	1	5
14-Sep-02	6	1				7
15-Sep-02	6	4				10
16-Sep-02	4	3				7
17-Sep-02	10	6				16
18-Sep-02	15	7				22
19-Sep-02	8	2		6	4	20
20-Sep-02	5	3		3	4	15
21-Sep-02	13	5		4	6	28
22-Sep-02	12	4				16
23-Sep-02	18	8				26
24-Sep-02	24	11				35
25-Sep-02	9	6				15
26-Sep-02	14	7	6			27
27-Sep-02	9	3		4	3	19
28-Sep-02	6	2		4	1	13
29-Sep-02	7	4		2	5	18
30-Sep-02	10	3			1	14
01-Oct-02	19	9				28
02-Oct-02	17	8				25
03-Oct-02	36	17				53
04-Oct-02	31	11				42
05-Oct-02	10	7		2	2	21
06-Oct-02	8	3				11
07-Oct-02	27	12				39
08-Oct-02	6	3	29			38
09-Oct-02	16	8				24
10-Oct-02	6	2	50			58
11-Oct-02	4	3				7
12-Oct-02	3	2				5
13-Oct-02	1	1	3			5
14-Oct-02	2	1	1			4
15-Oct-02	0	0	20			20
<b>Total</b>	<b>390</b>	<b>178</b>	<b>109</b>	<b>32</b>	<b>33</b>	<b>742</b>

## SEABECK CREEK (WRIA 15.0400)

### Summer Chum 2002

**Reach** River mile 0.0-0.7  
**Estimate** 0  
**Method** Peak live + dead count  
**Quality rating** Good  
**Comments** No live or dead chum observed on surveys from 9/16 to 10/31. Surveys conducted by Kitsap Stream Team (KST).

**Table 1.25.** Seabeck Creek 2002 chum survey data through Oct. 31.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
15 0400	09/16/02	0	0.7	0.7	0	0	0			EXCELLENT		INDEX	FOOT	KST
15 0400	09/23/02	0	0.7	0.7	0	0	0			EXCELLENT		INDEX	FOOT	KST
15 0400	10/03/02	0	0.7	0.7	0	0	0			EXCELLENT		INDEX	FOOT	KST
15 0400	10/10/02	0	0.7	0.7	0	0	0			EXCELLENT		INDEX	FOOT	KST
15 0400	10/15/02	0	0.7	0.7	0	0	0			EXCELLENT		INDEX	FOOT	KST
15 0400	10/21/02	0	0.7	0.7	0	0	0			EXCELLENT		INDEX	FOOT	KST
15 0400	10/31/02	0	0.7	0.7	0	0	0			EXCELLENT		INDEX	FOOT	KST

Notes:  
 10/03 - 3 redds and 1 live coho seen, but cannot positively assign redds to chum.

## STAVIS CREEK (WRIA 15.0404)

### Summer Chum 2002

**Reach** River mile 0.0-1.0  
**Estimate** 0  
**Method** Peak live + dead count  
**Quality rating** Fair  
**Comments** No chum observed on surveys from 09/13 to 10/21. Assumed chum on 10/31 were fall run. Surveys conducted by Kitsap Stream Team (KST).

**Table 1.26.** Stavis Creek 2002 chum survey data through Oct. 31.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
15 0404	09/13/02	0	1.0	1.0	0	0	0			GOOD		INDEX	FOOT	KST
15 0404	10/07/02	0	1.0	1.0	0	0	0			GOOD		INDEX	FOOT	KST
15 0404	10/15/02	0	1.0	1.0	0	0	0			GOOD		INDEX	FOOT	KST
15 0404	10/21/02	0	1.0	1.0	0	0	0			GOOD		INDEX	FOOT	KST
15 0404	10/31/02	0	1.0	1.0	3	0	3			GOOD		INDEX	FOOT	KST

Notes:  
 Beaver dam at RM 0.2 potential barrier to chum.  
 10/31 - 3 live chum and 1 redd, assumed to be fall chum.

## ***HARDING CREEK (WRIA 15.0408)***

### **Summer Chum 2002**

**Reach**                    **River mile 0.0-0.2**  
 Estimate                0  
 Method                 Peak live + dead count  
 Quality rating        Fair  
 Comments             No chum observed on surveys from 09/12 to 10/25. Surveys conducted by Kitsap Stream Team (KST).

**Table 1.27.** Harding Creek 2002 chum survey data through Oct. 25.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
15 0408	09/12/02	0	0.2	0.2	0	0	0			GOOD		INDEX	FOOT	KST
15 0408	09/24/02	0	0.2	0.2	0	0	0			GOOD		INDEX	FOOT	KST
15 0408	10/03/02	0	0.2	0.2	0	0	0			GOOD		INDEX	FOOT	KST
15 0408	10/18/02	0	0.2	0.2	0	0	0			GOOD		INDEX	FOOT	KST
15 0408	10/25/02	0	0.2	0.2	0	0	0			GOOD		INDEX	FOOT	KST

Notes:  
 Natural cascade 800 feet from mouth of creek, potential barrier to chum.

## ***ANDERSON CREEK (WRIA 15.0412)***

### **Summer Chum 2002**

**Reach**                    **River mile 0.0-1.0**  
 Estimate                0  
 Method                 See comments.  
 Quality rating        Poor  
 Comments             Assigned poor rating due to lack of surveys during September and October. Assumed escapement was zero due to apparent extirpation of the population, and no fish observed in spot surveys. Surveyors noted extensive beaver activity.

**Table 1.28.** Anderson Creek 2002 chum survey data through Nov. 19.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis*	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
15 0412	10/09/02	0	0.2	0.2	0	0	0	95	LOW	EXCELLENT	6	SPOT	FOOT	WDFW
15 0412	11/04/02	0	0.1	0.1	0	0	0	95	LOW	EXCELLENT	5	SPOT	FOOT	WDFW
15 0412	11/19/02	0	0.2	0.2	106	9	115	80	MEDIUM	GOOD	2	SPOT	FOOT	WDFW

Notes:  
 \* - Vis (% visible) values were not quantified by surveyor, but assigned based on Flow, Visibility, and Water clarity values.  
 10/09 - Multiple beaver dams. Partial survey.  
 11/04 - Heavy beaver activity.  
 11/19 - Partial survey. Big beaver dam was notched so fish are passing by lower areas.

## THOMAS CREEK (WRIA 15.0417)

### Summer Chum 2002

**Reach** River mile 0.0-0.1  
**Estimate** 1  
**Method** Peak live + dead count  
**Quality rating** Fair  
**Comments** Single dead chum observed on 10/03. Surveys conducted by Kitsap Stream Team.

**Table 1.29.** Thomas Creek 2002 chum survey data through Oct. 25.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
15 0417	09/12/02	0	0.1	0.1	0	0	0			GOOD		INDEX	FOOT	KST
15 0417	09/25/02	0	0.1	0.1	0	0	0			GOOD		INDEX	FOOT	KST
15 0417	10/03/02	0	0.1	0.1	0	1	1			GOOD		INDEX	FOOT	KST
15 0417	10/18/02	0	0.1	0.1	0	0	0			GOOD		INDEX	FOOT	KST
15 0417	10/25/02	0	0.1	0.1	0	0	0			GOOD		INDEX	FOOT	KST

Notes:  
10-03 - 1 dead chum and 1 redd observed.

## DEWATTO RIVER (WRIA 15.0420)

### Summer Chum 2002

**Reach** River mile 0.3-1.8  
**Estimate** 10  
**Method** AUC - 10 day stream life  
**Quality rating** Good  
**Comments** AUC, peak live counts both give estimate of 10 fish.

**Table 1.30.** Dewatto River 2002 chum survey data through Nov. 04.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis*	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
15 0420	09/13/02	0.3	1.8	1.5	0	0	0	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
15 0420	09/23/02	0.3	1.8	1.5	5	0	5	90	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
15 0420	10/02/02	0.3	1.8	1.5	0	3	3	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
15 0420	10/09/02	0.3	1.8	1.5	5	0	5	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
15 0420	10/18/02	0.3	1.8	1.5	1	2	3	95	LOW	EXCELLENT	4	INDEX	FOOT	WDFW
15 0420	10/25/02	0.3	1.8	1.5	0	0	0	90	LOW	VERY GOOD	3	INDEX	FOOT	WDFW
15 0420	11/04/02	0.3	1.8	1.5	47	2	49	95	LOW	EXCELLENT	5	INDEX	FOOT	WDFW

Notes:  
\* - Vis (% visible) values were not quantified by surveyor, but assigned based on Flow, Visibility, and Water clarity values.  
09/13 - At split point at Tom's cabin there has been a lot of cat work near and in stream area, mainly left bank area, in front of cabin and up stream. One redd at RM 0.4.  
10/25 - Glare, dark in some pools.

## ***TAHUYA RIVER (WRIA 15.0446)***

### **Summer Chum 2002**

**Reach** River mile 0.0-2.6  
**Estimate** 0  
**Method** See comments  
**Quality rating** Good  
**Comments** Escapement estimate was zero due to lack of fish observed from September 13 through October 25 surveys.

**Table 1.31.** Tahuya River 2002 chum survey data through Nov. 04.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis*	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
15 0446	09/13/02	0.0	2.6	2.6	0	0	0	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
15 0446	09/26/02	0.0	2.6	2.6	0	0	0	95	LOW	EXCELLENT	5	INDEX	FOOT	WDFW
15 0446	10/03/02	0.2	2.6	2.4	0	0	0	95	LOW	EXCELLENT	5	INDEX	FOOT	WDFW
15 0446	10/10/02	0.3	2.6	2.3	0	0	0	90	LOW	VERY GOOD	5	INDEX	FOOT	WDFW
15 0446	10/18/02	0.6	5.0	4.4	0	0	0	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
15 0446	10/25/02	1.0	2.6	1.6	0	0	0	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
15 0446	10/25/02	0.6	1.0	0.4	0	0	0	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
15 0446	10/25/02	2.6	5.0	2.4	0	0	0	95	LOW	EXCELLENT	6	SUPP	FOOT	WDFW
15 0446	11/04/02	1.0	2.6	1.6	56	0	56	95	LOW	EXCELLENT	5	INDEX	FOOT	WDFW

Notes:  
 \* - Vis (% visible) values were not quantified by surveyor, but assigned based on Flow, Visibility, and Water clarity values.  
 09/26 - Lower reach between river mile 0.8 to mouth is flowing in far left channel. With flows so low the far right channel is mostly dry.  
 10/10 - Lower end is deeply trenched.  
 10/25 - Beaver dam impass at low flow.

## ***UNION RIVER (WRIA 15.0503)***

### **Summer Chum 2002**

**Reach** River mile 0.3 upstream  
**Estimate** 807  
**Method** (Trap count) - (broodstock take adjustment)  
**Quality rating** Very Good  
**Comments** Trap was operated by Hood Canal Salmon Enhancement Group and WDFW from August 14 through October 9 to collect broodstock for the supplementation program. A total of 872 adults were trapped and 65 adults were removed for broodstock. Total return = (807 natural escapement) + (65 broodstock) = 872.

<b>Table 1.32. 2002 Union River summer chum trapping data.</b>									
<b>Date</b>	<b>Trapped</b>		<b>Spawned at trap</b>		<b>Date</b>	<b>Passed upstream</b>		<b>Spawned at trap</b>	
	<b>Female</b>	<b>Male</b>	<b>Female</b>	<b>Male</b>		<b>Female</b>	<b>Male</b>	<b>Female</b>	<b>Male</b>
8/14/02					9/12/02	20	17	10	10
8/15/02					9/13/02	15	23		
8/16/02					9/14/02	10	11		
8/17/02					9/15/02	8	10		
8/18/02					9/16/02	25	27	6	6
8/19/02					9/17/02	10	14		
8/20/02					9/18/02	4	11		
8/21/02	1	3			9/19/02	17	18		
8/22/02	0	0			9/20/02	18	24		
8/23/02	1	1			9/21/02	12	12		
8/24/02	0	0			9/22/02	7	8		
8/25/02	1	1			9/23/02	5	4	3	3
8/26/02	4	1			9/24/02	9	10		
8/27/02	0	2			9/25/02	11	9		
8/28/02	12	14			9/26/02	5	8		
8/29/02	9	11			9/27/02	8	7		
8/30/02	15	13			9/28/02	11	4		
8/31/02	11	5			9/29/02	8	4		
9/1/02	10	4			9/30/02	7	6	3	3
9/2/02	11	8			10/1/02	4	2		
9/3/02	8	10	4	4	10/2/02	4	3		
9/4/02	8	13			10/3/02	8	7		
9/5/02	6	14	4	4	10/4/02	6	8		
9/6/02	14	18			10/5/02	6	2		
9/7/02	17	23			10/6/02	1	6		
9/8/02	12	15			10/7/02	3	3		
9/9/02	10	16	3	2	10/8/02	1	2		
9/10/02	7	15			10/9/02	1	1		
9/11/02	9	14			<b>Total</b>	<b>410</b>	<b>462</b>	<b>33</b>	<b>32</b>

## ***SKOKOMISH RIVER (WRIA 16.0001)***

### **Summer Chum 2002**

<b>Reach</b>	<b>River mile 2.1 - 12.7</b>
Estimate	NA
Method	See comments
Quality rating	NA
Comments	Assumed chum on 10/18 were first of fall run due to lack of chum present in previous surveys. In the past, the Skokomish estimate has been treated as NA when summer chum were not observed during early season index surveys.

**Table 1.33.** Skokomish River 2002 chum survey data through Oct. 28.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis*	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
16 0001	08/24/2002	5.3	9.0	3.7	0	0	0	95	LOW	EXCELLENT	7	INDEX	RAFT	WDFW
16 0001	09/12/2002	2.1	5.3	3.2	0	0	0	75	LOW	FAIR	2	SUPP	RAFT	SKOK
16 0001	09/13/2002	5.3	9.0	3.7	0	0	0	95	LOW	EXCELLENT	6	INDEX	RAFT	WDFW
16 0001	09/17/2002	12.7	13.3	0.6	0	0	0	85	LOW	VERY GOOD	4	SUPP	FOOT	SKOK
16 0001	09/20/2002	9.0	12.7	3.7	0	0	0	85	LOW	VERY GOOD	4	INDEX	RAFT	SKOK
16 0001	09/23/2002	5.3	9.0	3.7	0	0	0	95	LOW	EXCELLENT	6	INDEX	RAFT	WDFW
16 0001	10/02/2002	5.3	9.0	3.7	0	0	0	95	LOW	EXCELLENT	6	INDEX	RAFT	WDFW
16 0001	10/04/2002	9.0	12.7	3.7	0	0	0	90	LOW	VERY GOOD	4	INDEX	RAFT	SKOK
16 0001	10/10/2002	2.1	5.3	3.2	0	0	0	90	LOW	VERY GOOD	4	SUPP	RAFT	SKOK
16 0001	10/11/2002	5.3	8.0	2.7	0	0	0	90	LOW	VERY GOOD	6	INDEX	RAFT	WDFW
16 0001	10/11/2002	8.0	9.0	1.0	0	0	0	90	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
16 0001	10/16/2002	13.3	15.0	1.7	0	0	0	90	LOW	VERY GOOD	5	SUPP	FOOT	SKOK
16 0001	10/17/2002	9.0	12.7	3.7	0	0	0	80	LOW	GOOD	4	INDEX	RAFT	SKOK
16 0001	10/18/2002	12.7	13.3	0.6	0	0	0	90	MEDIUM	VERY GOOD	6	SUPP	FOOT	SKOK
16 0001	10/18/2002	5.3	6.3	1.0	3	3	6	90	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
16 0001	10/18/2002	6.3	9.0	2.7	0	0	0	90	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
16 0001	10/24/2002	2.1	5.3	3.2	0	0	0	90	LOW	VERY GOOD	6	SUPP	RAFT	SKOK
16 0001	10/28/2002	5.3	6.3	1.0	13	0	13	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
16 0001	10/28/2002	6.3	8.0	1.7	6	2	8	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
16 0001	10/28/2002	8.0	9.0	1.0	2	0	2	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW

Notes:

\* - Vis (% visible) values were not quantified by surveyor, but assigned based on Flow, Visibility, and Water clarity values.

**FINCH CREEK (WRIA 16.0222)****Summer Chum 2002****Reach** River mile 0.0

Estimate 0

Method Rack count

Quality rating Good

Comments All chum trapped at Hoodspport Hatchery before 10/15 are returned to stream, to protect potential summer chum. In 2002, chum were trapped beginning 10/2, but it is unknown if they were summer chum. Due to late arrival timing and apparent extirpation of the population, assumed all chum trapped were early fall fish.

**Table 1.34.** 2002 chum daily trapping totals for Hoodspport Hatchery prior to Oct. 15.

Date	Adults	Released upstream	
	Trapped	Male	Female
10/02/02	1	1	
10/09/02	3	2	1
10/11/02	10	6	4
10/12/02	11	8	3
10/14/02	14	10	4

## **LITTLE LILLIWAUP CREEK (WRIA 16.0228)**

### **Summer Chum 2002**

**Reach** River mile 0.0-0.4  
**Estimate** 18  
**Method** AUC - 10 day stream life  
**Quality rating** Good  
**Comments** Curve well-defined throughout summer chum time period. Surveys by Skokomish tribe revealed 23 redds that may be, but are not confirmed to be, summer chum redds during September and October surveys.

**Table 1.35.** Little Lilliwaup Creek 2002 chum survey data through Nov. 06.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis*	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
16 0228	09/12/2002	0.0	0.4	0.4	0	0	0	95		EXCELLENT		INDEX	FOOT	SKOK
16 0228	09/20/2002	0.0	0.4	0.4	11	0	11	95		EXCELLENT		INDEX	FOOT	SKOK
16 0228	09/27/2002	0.0	0.4	0.4	7	0	7	95		EXCELLENT		INDEX	FOOT	SKOK
16 0228	10/03/2002	0.0	0.4	0.4	3	0	3	95		EXCELLENT		INDEX	FOOT	SKOK
16 0228	10/07/2002	0.0	0.4	0.4	2	2	4	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
16 0228	10/10/2002	0.0	0.4	0.4	4	1	5	95		EXCELLENT		INDEX	FOOT	SKOK
16 0228	10/15/2002	0.0	0.4	0.4	0	2	2	95	LOW	EXCELLENT	3	INDEX	FOOT	WDFW
16 0228	10/18/2002	0.0	0.4	0.4	0	1	1	95	LOW	EXCELLENT	4	INDEX	FOOT	WDFW
16 0228	10/22/2002	0.0	0.4	0.4	0	1	1	95	LOW	EXCELLENT	3	INDEX	FOOT	WDFW
16 0228	10/30/2002	0.0	0.4	0.4	0	0	0	95	LOW	EXCELLENT	10	INDEX	FOOT	WDFW
16 0228	11/06/2002	0.0	0.4	0.4	4	2	6	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW

Notes: \* - Vis (% visible) values were not quantified by surveyor, but assigned based on Flow, Visibility, and Water clarity values.  
 09/20 - 14 new redds; 09/27 - 2 new redds; 10/03 - 2 new redds; 10/10 - 5 new redds

## **LILLIWAUP CREEK (WRIA 16.0230)**

### **Summer Chum 2002**

**Reach** River mile 0.0-0.7  
**Estimate** 775  
**Method** AUC - 10-day stream life (w/ broodstock take adjustment)  
**Quality rating** Very Good  
**Comments** Assumed 10/22 fish represented the last summer chum, 10/30 the first of the fall run. 83 fish were collected for use in the supplementation program.  
 Adjusted escapement = [(8166 FD) - (83 broodstock x 5 days assumed residence time before removal)] / 10 day stream life = 775 fish.  
 Total return = (775 natural escapement) + (83 broodstock) = 858 fish.  
 A trap was installed but removed because the panels were repeatedly undermined by spawning summer chum (pers. comm., R. Endicott, LLTK).

**Table 1.36.** Lilliwaup Creek 2002 chum survey data through Nov. 06.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis*	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
16 0230	09/08/02	0	0.7	0.7	5	0	5	90	LOW	VERY GOOD	6	INDEX	FOOT	LLTK
16 0230	09/12/02	0	0.7	0.7	120	0	120	90	LOW	VERY GOOD	6	INDEX	FOOT	LLTK
16 0230	09/16/02	0	0.7	0.7	230	0	230	90	LOW	VERY GOOD	6	INDEX	FOOT	LLTK
16 0230	09/17/02	0	0.7	0.7	370	0	370	90	LOW	VERY GOOD	6	INDEX	FOOT	LLTK
16 0230	09/27/02	0	0.7	0.7	284	46	330	90	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
16 0230	10/07/02	0	0.4	0.4	152	163	315	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
16 0230	10/15/02	0	0.7	0.7	56	181	237	95	LOW	EXCELLENT	3	INDEX	FOOT	WDFW
16 0230	10/22/02	0	0.7	0.7	20	186	206	95	LOW	EXCELLENT	4	INDEX	FOOT	WDFW
16 0230	10/30/02	0	0.7	0.7	23	81	104	95	LOW	EXCELLENT	5	INDEX	FOOT	WDFW
16 0230	11/06/02	0.3	0.7	0.4	209	50	259	90	LOW	VERY GOOD	5.5	INDEX	FOOT	WDFW

Notes:

\* - With the exception of 09/27/02 data, Vis (% visible) values were not quantified by surveyor, but assigned based on Flow, Visibility, and Water clarity values.

## ***EAGLE CREEK (WRIA 16.0243)***

### **Summer Chum 2002**

**Reach** River mile 0.0-0.7

Estimate 0

Method Peak live + dead count

Quality rating Good

Comments Assumed fish on 10/15 were early fall chum due to absence of fish on surveys from 9/12 to 10/01.

**Table 1.37.** Eagle Creek 2002 chum survey data through Nov. 7.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis*	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
16 0243	09/12/2002	0	0.7	0.7	0	0	0	95		EXCELLENT		SUPP	FOOT	SKOK
16 0243	09/16/2002	0	0.7	0.7	0	0	0	95		EXCELLENT		SUPP	FOOT	SKOK
16 0243	09/20/2002	0	0.7	0.7	0	0	0	95		EXCELLENT		SUPP	FOOT	SKOK
16 0243	10/01/2002	0	0.7	0.7	0	0	0	95		EXCELLENT		SUPP	FOOT	SKOK
16 0243	10/15/2002	0	0.7	0.7	2	0	2	95	LOW	EXCELLENT	3	INDEX	FOOT	WDFW
16 0243	10/22/2002	0	0.7	0.7	1	0	1	95		EXCELLENT		INDEX	FOOT	SKOK
16 0243	10/22/2002	0	0.7	0.7	0	0	0	95	LOW	EXCELLENT	3	INDEX	FOOT	WDFW
16 0243	10/22/2002	0.7	1.2	0.5	0	0	0	95	LOW	EXCELLENT	3	INDEX	FOOT	WDFW
16 0243	10/30/2002	0	1.2	1.2	12	0	12	95	LOW	EXCELLENT	10	INDEX	FOOT	WDFW

Notes:

\* - Vis (% visible) values were not quantified by surveyor, but assigned based on Flow, Visibility, and Water clarity values.

## JORSTED CREEK (WRIA 16.0248)

### Summer Chum 2002

**Reach** River mile 0.0-0.7  
 Estimate 0  
 Method Peak live + dead count  
 Quality rating Poor  
 Comments Only one survey during September. No summer chum observed.

**Table 1.38.** Jorsted Creek 2002 chum survey data through Oct. 21.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
16 0248	09/09/2002	0	0.7	0.7	0	0	0			EXCELLENT		SUPP	FOOT	SKOK
16 0248	10/01/2002	0	0.7	0.7	0	0	0			EXCELLENT		SUPP	FOOT	SKOK
16 0248	10/21/2002	0	0.7	0.7	0	0	0			EXCELLENT		SUPP	FOOT	SKOK

## HAMMA HAMMA RIVER (WRIA 16.0251)

### Summer Chum 2002

**Reach** River mile 0.3-1.8  
 Estimate 2260  
 Method AUC - 10 day stream life (w/ broodstock take adjustment)  
 Quality rating Good  
 Comments Front end of curve was not well defined by foot surveys, so snorkel surveys were included for AUC estimate. 68 fish were collected for supplementation program. Adjusted escapement = [(22943 FD) - (68 broodstock x 5 days assumed average residence before removal)] / (10 day stream life) = 2260 fish.  
 Total return = (2260 natural esc.) + (68 broodstock) = 2328.

**Table 1.39.** Hamma Hamma River 2002 chum survey data through Nov. 7.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis*	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
16 0251	08/19/02	0.3	1.3	1	0	0	0	99	LOW	EXCELLENT	6	INDEX	SNORKEL	LLTK
16 0251	08/23/02	0.3	1.8	1.5	80	0	80	90	LOW	VERY GOOD	6	INDEX	SNORKEL	LLTK
16 0251	08/27/02	0.3	1.8	1.5	135	0	135	90	LOW	VERY GOOD	6	INDEX	SNORKEL	LLTK
16 0251	08/30/02	0.3	1.8	1.5	200	0	200	90	LOW	VERY GOOD	6	INDEX	SNORKEL	LLTK
16 0251	09/02/02	0.3	1.8	1.5	250	0	250	90	LOW	VERY GOOD	6	INDEX	SNORKEL	LLTK
16 0251	09/06/02	0.3	1.8	1.5	310	0	310	90				INDEX	FOOT	WDFW
16 0251	09/18/02	0.3	1.8	1.5	551	12	563	90	LOW	VERY GOOD	4	INDEX	FOOT	WDFW
16 0251	09/27/02	0.3	1.8	1.5	736	147	883	90	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
16 0251	10/07/02	0.3	1.8	1.5	374	415	789	90	LOW	VERY GOOD	5	INDEX	FOOT	WDFW
16 0251	10/17/02	0.3	1.8	1.5	28	371	399	95	LOW	EXCELLENT	20	INDEX	FOOT	WDFW
16 0251	11/07/02	0.3	1.8	1.5	576	22	598	80	MEDIUM	GOOD	4	INDEX	FOOT	WDFW

Notes:

\* - With the exception of 08/19, 09/06, and 09/27 data, Vis (% visible) values were not quantified by surveyor, but assigned based on Flow, Visibility, and Water clarity values.

## ***JOHN CREEK (WRIA 16.0253)***

### **Summer Chum 2002**

**Reach** River mile 0.0-1.6  
**Estimate** 0  
**Method** Peak live + dead  
**Quality rating** Very good  
**Comments** The mouth of John Creek was dry during summer chum run, preventing access.

**Table 1.40.** John Creek 2002 chum survey data through Nov. 7.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis*	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
16 0253	09/27/02	0	0.1	0.1	0	0	0	95	LOW	EXCELLENT	4	SPOT	FOOT	WDFW
16 0253	10/07/02	0	0.1	0.1	0	0	0	95	LOW	EXCELLENT	2	SPOT	FOOT	WDFW
16 0253	11/07/02	0	1.6	1.6	19	0	19	95	MEDIUM	EXCELLENT	4	INDEX	FOOT	WDFW

Notes: \* - Vis (% visible) values were not quantified by surveyor, but assigned based on Flow, Visibility, and Water clarity values.  
 09/27 - Mouth of creek dry; 10/07 - Mouth of creek dry

## ***FULTON CREEK (WRIA 16.0332)***

### **Summer Chum 2002**

**Reach** River mile 0.0-0.8  
**Estimate** 0  
**Method** Peak live + dead  
**Quality rating** Poor  
**Comments** Only one survey during September. No summer chum observed.

**Table 1.41.** Fulton Creek 2002 chum survey data through Oct. 20.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
16 0332	09/12/2002	0	0.8	0.8	0	0	0			EXCELLENT		SUPP	FOOT	SKOK
16 0332	10/01/2002	0	0.8	0.8	0	0	0			EXCELLENT		SUPP	FOOT	SKOK
16 0332	10/20/2002	0	0.8	0.8	0	0	0			EXCELLENT		SUPP	FOOT	SKOK

## ***DUCKABUSH RIVER (WRIA 16.0351)***

### **Summer Chum 2002**

**Reach** River mile 0.0-2.3  
**Estimate** 530  
**Method** AUC - 10 day stream life  
**Quality rating** Good  
**Comments** Ascending side of curve not well defined, no dead counts on 9/15 or 9/25.  
 Assumed 9/15 was peak live day.

**Table 1.42.** Duckabush River 2002 chum survey data through Nov. 7.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis*	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
16 0351	08/22/02	0	2.3	2.3	3	0	3	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
16 0351	09/05/02	0	2.3	2.3	51	0	51	90				INDEX	FOOT	WDFW
16 0351	09/15/02	0	2.3	2.3	209		209	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
16 0351	09/25/02	0	2.3	2.3	164		164	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
16 0351	10/03/02	0	2.3	2.3	105	225	330	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
16 0351	10/11/02	0	2.3	2.3	7	93	100	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
16 0351	10/21/02	0	2.3	2.3	12	124	136	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
16 0351	10/31/02	0	2.3	2.3	7	21	28	95	LOW	EXCELLENT	5	INDEX	FOOT	WDFW
16 0351	11/07/02	0	0.01	0.01	0	0	0	50	MEDIUM	POOR	0.5	SPOT	FOOT	WDFW

Notes:  
 \* - With the exception of 09/15 and 09/25 data, Vis (% visible) values were not quantified by surveyor, but assigned based on flow, visibility, and water clarity values.

## **DOSEWALLIPS RIVER (WRIA 16.0442)**

### **Summer Chum 2002**

**Reach** River mile 0.1-2.3  
**Estimate** 1627  
**Method** AUC - 10 day stream life  
**Quality rating** Good  
**Comments** Ascending side of curve not well defined, no dead counts on 9/15 or 10/03.  
 Assumed 9/15 was peak live day.

**Table 1.43.** Dosewallips River 2002 chum survey data through Oct. 21.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis*	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
16 0442	08/22/02	0.1	2.3	2.3	2	0	2	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
16 0442	09/05/02	0.1	2.3	2.3	255	0	255	90				INDEX	FOOT	WDFW
16 0442	09/15/02	0.1	2.3	2.3	611		611	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
16 0442	09/24/02	0.1	2.3	2.3	547	179	726	95	LOW	EXCELLENT	5	INDEX	FOOT	WDFW
16 0442	10/03/02	0.1	2.3	2.3	194		194	95	LOW	VERY GOOD	4	INDEX	FOOT	WDFW
16 0442	10/11/02	0.1	2.3	2.3	8	76	84	95	LOW	EXCELLENT	4	INDEX	FOOT	WDFW
16 0442	10/21/02	0.1	2.3	2.3	4	64	68	90	LOW	VERY GOOD	6	INDEX	FOOT	WDFW

Notes:  
 \* - With the exception of 09/15 and 10/03 data, Vis (% visible) values were not quantified by surveyor, but assigned based on flow, visibility, and water clarity values.  
 09/24 - Some glare, heavy predation.

## ***BIG QUILCENE RIVER (WRIA 17.0012)***

### **Summer Chum 2002**

**Reach** River mile 0.0-2.7  
**Estimate** 3662  
**Method** AUC - 10 day stream life  
**Quality rating** Very Good  
**Comments** Entire curve well-defined. Dead counts not conducted for much of run. USFWS captured 360 broodstock by beach seine in Quilcene Bay (of these 5 died during capture).  
 Total return = (3662 natural esc.) + (360 broodstock) = 4022.

**Table 1.44.** Big Quilcene River 2002 chum survey data through Nov. 13.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis*	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
17 0012	08/31/02	0.8	1.8	1	2		2	98	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	08/31/02	1.8	2.7	0.9	6		6	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	09/09/02	0.8	1.8	1	49	8	57	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	09/09/02	0	0.8	0.8	432	40	472	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	09/09/02	1.8	2.7	0.9	53	2	55	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	09/16/02	0	0.8	0.8	1518		1518	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	09/16/02	1.8	2.7	0.9	259		259	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	09/16/02	0.8	1.8	1	367		367	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	09/23/02	0	0.8	0.8	984		984	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	09/23/02	0.8	1.8	1	140		140	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	09/23/02	1.8	2.7	0.9	29		29	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	10/02/02	0	0.8	0.8	477		477	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	10/02/02	0.8	1.8	1	16		16	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	10/02/02	1.8	2.7	0.9	2		2	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0012	10/10/02	0	0.8	0.8	276		276	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
17 0012	10/10/02	0.8	1.8	1	6		6	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
17 0012	10/10/02	1.8	2.7	0.9	0		0	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
17 0012	10/17/02	0	0.8	0.8	88	0	88	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
17 0012	11/13/02	0	0.8	0.8	6	0	6	90	LOW	VERY GOOD	3	INDEX	FOOT	WDFW

## ***LITTLE QUILCENE RIVER (WRIA 17.0076)***

### **Summer Chum 2002**

**Reach** River mile 0.0-1.8  
**Estimate** 470  
**Method** AUC - 10 day stream life  
**Quality rating** Very good  
**Comments** Entire curve well-defined. Dead counts not conducted for much of run.

**Table 1.45. Little Quilcene River 2002 chum survey data through Nov. 13 .**

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
17 0076	08/31/02	0	0.8	0.8	2		2	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0076	09/10/02	0.8	1.8	1	0		0	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0076	09/10/02	0	0.8	0.8	56		56	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0076	09/17/02	0.8	1.8	1	3		3	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0076	09/17/02	0	0.8	0.8	225		225	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0076	09/23/02	0	0.8	0.8	164		164	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0076	09/23/02	0.8	1.8	1	4		4	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0076	10/01/02	0	0.8	0.8	114	138	252	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0076	10/01/02	0.8	1.8	1	0	0	0	95	LOW	VERY GOOD	6	INDEX	FOOT	WDFW
17 0076	10/10/02	0	0.8	0.8	54		54	95	LOW	EXCELLENT	6	INDEX	FOOT	WDFW
17 0076	10/17/02	0	0.8	0.8	10		10	95	LOW	VERY GOOD	4	INDEX	FOOT	WDFW
17 0076	11/13/02	0	0.8	0.8	6	0	6	90	LOW	VERY GOOD	3	INDEX	FOOT	WDFW

## **CHIMACUM CREEK (WRIA 17.0203)**

### **Summer Chum 2002**

**Reach** River mile 0.0-1.0  
**Estimate** 864  
**Method** AUC - 10 day stream life  
**Quality rating** Very good  
**Comments** Entire curve well-defined. Surveys conducted by Wild Olympic Salmon and North Olympic Salmon Coalition.

**Table 1.46. Chimacum Creek 2002 chum survey data through Oct. 16.**

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
17.0203	09/04/02	0	0.2	0.2	0	5	5	90	LOW	GOOD	1	INDEX	FOOT	WOS
17.0203	09/04/02	0.2	1	0.8	1	0	1	80	LOW	GOOD	2	INDEX	FOOT	WOS
17.0203	09/11/02	0	0.2	0.2	18	4	22	85	LOW	VERY GOOD	2	INDEX	FOOT	WOS
17.0203	09/11/02	0.2	1	0.8	19	1	20	85	LOW	VERY GOOD	2	INDEX	FOOT	WOS
17.0203	09/18/02	0.2	1	0.8	122	23	145	90	LOW	GOOD	1	INDEX	FOOT	WOS
17.0203	09/18/02	0	0.2	0.2	40	14	54	90	LOW	VERY GOOD	1	INDEX	FOOT	WOS
17.0203	09/25/02	0	0.2	0.2	49	48	97	85	LOW	VERY GOOD	2	INDEX	FOOT	WOS
17.0203	09/25/02	0.2	1	0.8	213	79	292	80	LOW	VERY GOOD	2	INDEX	FOOT	WOS
17.0203	10/02/02	0	0.2	0.2	35	89	124	70	LOW	FAIR	0.1	INDEX	FOOT	WOS
17.0203	10/02/02	0.2	1	0.8	194	161	355	95	LOW	VERY GOOD	4	INDEX	FOOT	WOS
17.0203	10/09/02	0	0.2	0.2	37	106	143	90	LOW	VERY GOOD	2	INDEX	FOOT	WOS
17.0203	10/09/02	0.2	1	0.8	374	214	588	90	LOW	VERY GOOD	2	INDEX	FOOT	WOS
17.0203	10/16/02	0	0.2	0.2	12	106	118	95	LOW	VERY GOOD	4	INDEX	FOOT	WOS
17.0203	10/16/02	0.2	1	0.8	47	143	190	95	LOW	VERY GOOD	4	INDEX	FOOT	WOS

## ***SNOW CREEK (WRIA 17.0219)***

### **Summer Chum 2002**

**Reach** River mile 0.0 - 0.8  
**Estimate** 532  
**Method** Trap count + (downstream redd count adjustment)  
**Quality rating** Very Good  
**Comments** Trap was operated continuously at RM 0.8 by WDFW from September 1 through October 29. 339 adults were passed upstream. 70 redds were counted downstream of trap; assuming 1 female per redd, and using sex ratio from trap of 1.756 males/female, an estimated 193 fish spawned downstream.  
 Total return = (339 upstream esc.) + (193 downstream esc.) = 532.

**Table 1.47.** 2002 Snow Creek summer chum trapping data and downstream redd data.

Date	Passed upstream of trap			Redds downstream	Date	Passed upstream of trap			Redds downstream
	Female	Male	Total			Female	Male	Total	
09/01/2002	0	0	0		10/01/2002	4	5	9	
09/02/2002	0	0	0		10/02/2002	5	8	13	
09/03/2002	0	0	0		10/03/2002	17	37	54	
09/04/2002	0	0	0		10/04/2002	10	23	33	16
09/05/2002	0	0	0		10/05/2002	7	13	20	
09/06/2002	0	0	0		10/06/2002	7	16	23	
09/07/2002	0	0	0	0	10/07/2002	5	4	9	
09/08/2002	0	0	0		10/08/2002	6	11	17	
09/09/2002	0	0	0		10/09/2002	6	10	16	
09/10/2002	0	0	0		10/10/2002	4	7	11	
09/11/2002	0	0	0		10/11/2002	0	2	2	
09/12/2002	0	0	0		10/12/2002	2	1	3	14
09/13/2002	0	0	0	3	10/13/2002	0	0	0	
09/14/2002	0	0	0		10/14/2002	1	2	3	
09/15/2002	0	0	0		10/15/2002	0	1	1	
09/16/2002	0	0	0		10/16/2002	1	1	2	
09/17/2002	0	0	0		10/17/2002	1	0	1	
09/18/2002	0	0	0		10/18/2002	0	1	1	
09/19/2002	0	0	0		10/19/2002	0	0	0	
09/20/2002	1	2	3	8	10/20/2002	0	0	0	
09/21/2002	0	0	0		10/21/2002	0	2	2	
09/22/2002	0	0	0		10/22/2002	0	0	0	14
09/23/2002	1	3	4		10/23/2002	0	0	0	
09/24/2002	1	2	3		10/24/2002	0	0	0	
09/25/2002	3	4	7		10/25/2002	0	0	0	
09/26/2002	2	2	4	15	10/26/2002	0	0	0	
09/27/2002	4	5	9		10/27/2002	0	0	0	
09/28/2002	9	13	22		10/28/2002	0	1	1	
09/29/2002	13	24	37		10/29/2002	1	0	1	
09/30/2002	12	16	28		<b>Total</b>	<b>123</b>	<b>216</b>	<b>339</b>	<b>70</b>

## SALMON CREEK (WRIA 17.0245)

### Summer Chum 2002

**Reach** River mile 0.0 upstream  
**Estimate** 5389  
**Method** (Trap count) - (broodstock take adjustment) + (downstream redd count adjustment)  
**Quality rating** Very good  
**Comments** Trap was installed at RM 0.3 by WDFW on August 31 and operated through October 31 as part of a supplementation program. 5,198 fish were passed upstream. 87 redds were counted downstream; assuming 1 female per redd, and using sex ratio from trap of 1.188 males per female, an estimated 191 fish spawned downstream. Additional 128 adults collected for broodstock.  
 Total return = (5198 + 191 natural escapement) + (128 broodstock) = 5,517.

**Table 1.48.** 2002 Salmon Creek summer chum trapping data and downstream redd data.

Date	Passed upstream		Spawned at trap		Redds downstream	Date	Passed upstream		Spawned at trap		Redds downstream
	Female	Male	Female	Male			Female	Male	Female	Male	
08/31/02						10/01/02	74	78			
09/01/02	1	0				10/02/02	84	77			
09/02/02	0	0				10/03/02	346	434			
09/03/02	1	1				10/04/02	40	84			
09/04/02	0	2				10/05/02	79	53			
09/05/02	3	10				10/06/02	54	47			
09/06/02	9	21				10/07/02	63	65			
09/07/02	14	35				10/08/02	42	26			
09/08/02	9	23				10/09/02	33	32			
09/09/02	35	62				10/10/02	29	32			
09/10/02	21	54				10/11/02	35	30			
09/11/02	50	113	10	10		10/12/02	19	22			
09/12/02	32	52				10/13/02	13	11			
09/13/02	34	48				10/14/02	5	5			
09/14/02	30	49				10/15/02	10	9			
09/15/02	23	44				10/16/02	26	25			
09/16/02	27	39	13	13		10/17/02	47	30			
09/17/02	83	226				10/18/02	45	45			
09/18/02	51	47				10/19/02	43	36			38
09/19/02	22	15	11	11		10/20/02	39	28			
09/20/02	54	40				10/21/02	16	16			
09/21/02	47	43				10/22/02	16	19			
09/22/02	53	57				10/23/02	4	6			
09/23/02	30	22	20	20	49	10/24/02	3	1			
09/24/02	75	72				10/25/02	4	5			
09/25/02	89	87				10/26/02	6	5			
09/26/02	54	56				10/27/02	2	2			
09/27/02	102	117				10/29/02	8	8			
09/28/02	75	108				10/30/02	0	0			
09/29/02	60	73				10/31/02	1	0			
09/30/02	100	81	10	10		<b>Total</b>	<b>2370</b>	<b>2828</b>	<b>64</b>	<b>64</b>	<b>87</b>

## JIMMYCOMELATELY CREEK (WRIA 17.0285)

### Summer Chum 2002

**Reach** River mile 0.0 upstream  
**Estimate** 6  
**Method** (Trap count) - (broodstock take adjustment) + (downstream redd count adjustment)  
**Quality rating** Very good  
**Comments** Trap operated continuously by WDFW and North Olympic Salmon Coalition at RM 0.1 from August 28 through October 21 as part of a supplementation program. 36 fish removed for broodstock (includes 9 mortalities, 8 of which were males for which mates were never trapped). Downstream spawning escapement = 6 (estimated from redd count adjusted for spawn-outs entering trap). Additional 15 fish pre-escapement loss downstream due to predation.  
 Total return = (6 natural esc.) + (36 broodstock) + (15 pre-escapement loss) = 57.

**Table 1.49.** 2002 summer chum trapping totals, downstream redd counts, and pre-escapement loss from Jimmycomelately Creek

Date	Adults trapped		Spawned at trap		Downstream redds	Pre-escapement loss		Notes
	Female	Male	Female	Male		Female	Male	
08/28/02								Trap installed
09/13/02	1	1			1			
09/14/02	3	4				1	1	1 female spawn-out, died in tube on 9/16
09/15/02	4	6					1	
09/16/02			3	2	3	3	2	2 females were partial spawn-outs
09/17/02	4	6						
09/18/02						1	1	Fish found on secondary channel by dike
09/19/02			6	6				
09/20/02	1	3						
09/21/02								
09/22/02								
09/23/02			3	3				
09/24/02								
09/25/02						1		
09/26/02						2	2	
09/27/02								
09/28/02	1	1						
09/29/02	1							
09/30/02			2	2				
10/01/02								
10/02/02								
10/03/02								
10/04/02								
10/05/02								
10/06/02								
10/07/02								2 male mortalities in tubes
10/13/02								3 male mortalities in tubes
10/17/02								2 male mortalities in tubes
10/18/02								
10/19/02								1 male mortality in tubes
10/21/02								Trap removed
<b>Totals</b>	<b>15</b>	<b>21</b>	<b>14</b>	<b>13</b>	<b>4</b>	<b>8</b>	<b>7</b>	

## DUNGENESS RIVER (WRIA 18.0018)

### Summer Chum 2002

**Reach** River mile 0.0 upstream  
**Estimate** 1  
**Method** Peak live + dead  
**Quality rating** Fair  
**Comments** Regular surveys were conducted from August through early October. Data presented here are summaries of those multi-day surveys. One dead chum was observed on a survey August 21.

**Table 1.50.** Dungeness River 2002 chum survey data through October 7.

WRIA	Date	Lower RM	Upper RM	Length	Live	Dead	Live + Dead	Vis	Flow	Visibility	Water clarity (ft)	Survey type	Survey method	Agency
18 0018	08/05/2002	0.9	17.5	16.6	0	0	0	75	MOD	GOOD		INDEX	FOOT	WDFW
18 0018	08/12/2002	0.9	18.7	17.8	0	0	0	80	MOD	VERY GOOD		INDEX	FOOT	WDFW
<b>18 0018</b>	<b>08/19/2002</b>	<b>0.9</b>	<b>18.7</b>	<b>17.8</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>80</b>	<b>M-LOW</b>	<b>VERY GOOD</b>		<b>INDEX</b>	<b>FOOT</b>	<b>WDFW</b>
18 0018	08/27/2002	0.9	18.7	17.8	0	0	0	80	M-LOW	VERY GOOD		INDEX	FOOT	WDFW
18 0018	09/03/2002	0.9	18.7	17.8	0	0	0	80	M-LOW	VERY GOOD		INDEX	FOOT	WDFW
18 0018	09/09/2002	0.0	18.7	18.7	0	0	0	80	M-LOW	VERY GOOD		INDEX	FOOT	WDFW
18 0018	09/16/2002	0.0	15.8	15.8	0	0	0	80	M-LOW	VERY GOOD		INDEX	FOOT	WDFW
18 0018	09/23/2002	0.0	13.8	13.8	0	0	0	80	M-LOW	VERY GOOD		INDEX	FOOT	WDFW
18 0018	10/01/2002	0.0	12.0	12.0	0	0	0	85	M-LOW	VERY GOOD		INDEX	FOOT	WDFW
18 0018	10/07/2002	0.0	10.8	10.8	0	0	0	85	M-LOW	VERY GOOD		INDEX	FOOT	WDFW

Notes:  
08/05 - Multi-day chinook survey conducted from 8/05 to 8/09; no chum observed.  
08/12 - Multi-day chinook survey conducted from 8/12 to 8/16; no chum observed.  
08/19 - Multi-day chinook survey conducted from 8/19 to 8/23; one dead chum observed in 0.9 to 3.3 reach on 8/21.  
08/27 - Multi-day chinook survey conducted from 8/27 to 8/30; no chum observed.  
09/03 - Multi-day chinook survey conducted from 9/03 to 9/06; no chum observed.  
09/09 - Multi-day chinook survey conducted from 9/09 to 9/13; no chum observed.  
09/16 - Multi-day chinook survey conducted from 9/16 to 9/20; no chum observed.  
09/23 - Multi-day chinook survey conducted from 9/23 to 9/27; no chum observed.  
10/01 - Multi-day chinook survey conducted from 10/01 to 10/04; no chum observed.  
10/07 - Multi-day chinook survey conducted from 10/07 to 10/14; no chum observed.

## ***APPENDIX REPORT 2***

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### ***SUMMER CHUM SALMON RUN RECONSTRUCTION - 1974-2002 RETURN YEARS.***

The following tables present the run reconstruction estimates for the entire summer chum salmon data base; return years 1974 through 2002. The estimates for all returns since 1974 are included here, because a number of values have been updated from those originally presented in the SCSCI (see Table 4 above).

Reconstruction of the HC-SJF Summer Chum Salmon Runs

1974

<b>Harvest</b>	356	0	0	0	0	13	13	0	0	0	0	0	191	188	1,399
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		***** Run Abundance by Location *****											Seattle	Admiralty	U.S.	CDN		
Mgmt Unit	Prod. Unit	Escape	Brood	82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20
Skokomish	Skokomish	N/A		356		356			356	357	357			357	357	361	366	401
12D	Tahuya	880			880	880			881	882	882			950	950	962	975	1,067
	Union	68			68	68			68	68	68							
12A	L. Quilcene	44						44	44	44	44			841	841	852	863	944
	B. Quilcene	795					795	795	796	797	797							
12-12B-12C	Big Beef	75							75	75	75			10,515	10,515	10,654	10,791	11,810
	Anderson	0							0	0	0							
	Dosewallips	<b>3,593</b>							3,596	3,600	3,600							
	Duckabush	3,581							3,585	3,588	3,588							
	Hamma	<b>2,448</b>							2,451	2,453	2,453							
	Lilliwaup	616				616			617	617	617							
	Dewatto	181				181			181	181	181							
Discovery	Snow	818										818		1,330		1,348	1,365	1,494
	Salmon	512										512						
Sequim	JCL	<b>438</b>											438	438		443	449	492
<b>Totals</b>		14,049	0	356	948	2,101	795	839	12,650	12,662	12,662	1,330	438	14,430	12,662	14,620	14,809	16,207
	Hood Canal Portion	12,281	0											12,662	12,662	12,829	12,994	14,222
	E. Strait Portion	1,768	0											1,768		1,791	1,814	1,985

Note: Values in bold italics were estimated indirectly

1975

<b>Harvest</b>	1,118	54	4,010	0	372	3,664	78	0	205	0	0	54	546	1,064
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		***** Run Abundance by Location *****											Seattle	Admiralty	U.S.	CDN		
Mgmt Unit	Prod. Unit	Escape	Brood	82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20
Skokomish	Skokomish	N/A		1,118		2,249			2,595	2,602	2,602			2,602	2,602	2,607	2,656	2,751
12D	Tahuya	1,389			1,440	2,897			3,342	3,352	3,352			3,555	3,555	3,561	3,628	3,757
	Union	<b>84</b>			87	175			202	203	203							
12A	L. Quilcene	868					1,010		1,166	1,169	1,169			3,061	3,061	3,066	3,124	3,235
	B. Quilcene	1,405					1,405	1,635	1,887	1,892	1,892							
12-12B-12C	Big Beef	1,152							1,329	1,333	1,333			18,326	18,326	18,360	18,702	19,370
	Anderson	195							225	226	226							
	Dosewallips	<b>2,250</b>							2,596	2,604	2,604							
	Duckabush	2,245							2,591	2,598	2,598							
	Hamma	<b>7,341</b>							8,471	8,495	8,495							
	Lilliwaup	706				1,420			1,639	1,643	1,643							
	Dewatto	613				1,233			1,423	1,427	1,427							
Discovery	Snow	340										404		1,300		1,302	1,327	1,374
	Salmon	755										896						
Sequim	JCL	<b>353</b>											353	353		353	360	373
<b>Totals</b>		19,696	0	1,118	1,527	7,974	1,405	2,645	27,466	27,543	27,543	1,300	353	29,196	27,543	29,250	29,796	30,860
	Hood Canal Portion	18,248	0											27,543	27,543	27,594	28,110	29,113
	E. Strait Portion	1,448	0											1,653		1,656	1,686	1,747

Note: Values in bold italics were estimated indirectly

Reconstruction of the HC-SJF Summer Chum Salmon Runs

1976

<b>Harvest</b>	991	618	26,150	0	5,704	4,047	87	0	0	0	968	1,486	929	5,705
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Mgmt Unit	Prod. Unit	Escape	Brood	***** Run Abundance by Location *****									Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN
				82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)				(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		991		4,560			4,861	4,868	4,868			4,868	4,940	5,048	5,116	5,532	
12D	Tahuya	3,200			3,799	17,480			18,636	18,661	18,661			19,244	19,530	19,958	20,225	21,869	
	Union	100			119	546			582	583	583								
12A	L. Quilcene	1,088						2,845	3,033	3,037	3,037			9,861	10,007	10,227	10,364	11,206	
	B. Quilcene	2,445					2,445	6,392	6,815	6,824	6,824								
12-12B-12C	Big Beef	1,281							1,366	1,368	1,368			31,339	31,803	32,500	32,936	35,613	
	Anderson	234							249	250	250								
	Dosewallips	3,271							3,487	3,492	3,492								
	Duckabush	6,095							6,498	6,507	6,507								
	Hamma	<b>7,648</b>							8,154	8,165	8,165								
	Lilliwaup	1,612				7,417			7,907	7,918	7,918								
	Dewatto	741				3,409			3,635	3,640	3,640								
Discovery	Snow	608										608		1,129		1,154	1,169	1,264	
	Salmon	521										521							
Sequim	JCL	<b>365</b>											365	365		373	378	409	

<b>Totals</b>		29,209	0	991	3,918	33,412	2,445	9,237	65,225	65,311	65,311	1,129	365	66,805	66,279	69,259	70,188	<b>75,893</b>
	Hood Canal Portion	27,715	0											65,311	66,279	67,732	68,641	<b>74,220</b>
	E. Strait Portion	1,494	0											1,494		1,527	1,547	<b>1,673</b>

Note: Values in bold italics were estimated indirectly

1977

<b>Harvest</b>	320	7	3,015	0	24	590	489	0	0	0	1	73	711	913
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Mgmt Unit	Prod. Unit	Escape	Brood	***** Run Abundance by Location *****									Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN
				82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)				(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		320		864			900	930	930			930	930	934	974	1,024	
12D	Tahuya	726			732	1,978			2,061	2,129	2,129			2,349	2,349	2,359	2,459	2,587	
	Union	75			76	204			213	220	220								
12A	L. Quilcene	773						785	817	845	845			1,742	1,742	1,750	1,823	1,918	
	B. Quilcene	821					821	833	868	897	897								
12-12B-12C	Big Beef	302							315	325	325			10,134	10,135	10,179	10,608	11,159	
	Anderson	<b>26</b>							27	28	28								
	Dosewallips	3,215							3,350	3,461	3,461								
	Duckabush	2,453							2,556	2,641	2,641								
	Hamma	<b>1,675</b>							1,745	1,803	1,803								
	Lilliwaup	420				1,134			1,182	1,221	1,221								
	Dewatto	225				608			633	654	654								
Discovery	Snow	538										538		1,239		1,244	1,297	1,364	
	Salmon	701										701							
Sequim	JCL	<b>405</b>											405	405		406	424	446	

<b>Totals</b>		12,355	0	320	808	4,788	821	1,618	14,667	15,155	15,155	1,239	405	16,799	15,156	16,873	17,584	<b>18,498</b>
	Hood Canal Portion	10,711	0											15,155	15,156	15,222	15,864	<b>16,688</b>
	E. Strait Portion	1,644	0											1,644		1,651	1,720	<b>1,810</b>

Note: Values in bold italics were estimated indirectly

Reconstruction of the HC-SJF Summer Chum Salmon Runs

1978

<b>Harvest</b>	130	0	2,036	0	1	386	1,817	6	0	0	0	167	552	701
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Mgmt Unit	Prod. Unit	Escape	Brood	***** Run Abundance by Location *****									Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN
				82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)				(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		130		243				248	268	268		268	268	270	275	282	
12D	Tahuya	266			266	498				507	548	548		680	680	684	698	716	
	Union	64			64	120				122	132	132							
12A	L. Quilcene	1,816						1,816	1,848	1,999	2,000			5,279	5,279	5,312	5,419	5,555	
	B. Quilcene	2,978					2,978	2,979	3,031	3,279	3,279								
12-12B-12C	Big Beef	680								692	748	749		17,858	17,858	17,968	18,331	18,791	
	Anderson	16								16	18	18							
	Dosewallips	<b>1,901</b>								1,935	2,093	2,093							
	Duckabush	1,898								1,931	2,089	2,090							
	Hamma	<b>8,215</b>								8,360	9,043	9,045							
	Lilliwaup	1,331				2,492				2,536	2,742	2,743							
	Dewatto	544				1,018				1,036	1,121	1,121							
Discovery	Snow	629											629		2,293		2,307	2,354	
	Salmon	1,664											1,664					2,413	
Sequim	JCL	<b>787</b>												787	787		791	807	
<b>Totals</b>		22,789	0	130	330	4,371	2,978	4,795	22,263	24,080	24,086	2,293	787	27,165	24,086	27,332	27,883	<b>28,584</b>	
	Hood Canal Portion	19,710	0											24,086	24,086	24,233	24,722	<b>25,344</b>	
	E. Strait Portion	3,080	0											3,080		3,098	3,161	<b>3,240</b>	

Note: Values in bold italics were estimated indirectly

1979

<b>Harvest</b>	31	0	950	0	137	219	147	0	0	0	0	2	134	889	591
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Mgmt Unit	Prod. Unit	Escapement	Brood	***** Run Abundance by Location *****									Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN
				82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)				(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		31		95				98	100	100		100	100	102	112	118	
12D	Tahuya	117			117	360				370	377	377		690	690	701	771	817	
	Union	<b>97</b>			97	299				307	313	313							
12A	L. Quilcene	110						143	147	150	150			620	620	630	692	734	
	B. Quilcene	345					345	449	462	470	470								
12-12B-12C	Big Beef	191								196	200	200		6,627	6,628	6,729	7,399	7,844	
	Anderson	6								6	6	6							
	Dosewallips	<b>1,190</b>								1,224	1,246	1,246							
	Duckabush	1,190								1,224	1,247	1,247							
	Hamma	<b>3,096</b>								3,185	3,244	3,244							
	Lilliwaup	163				502				516	526	526							
	Dewatto	49				151				155	158	158							
Discovery	Snow	133											133		591		600	660	
	Salmon	458											458					699	
Sequim	JCL	<b>170</b>												170	170		173	190	
<b>Totals</b>		7,315	0	31	214	1,407	345	592	7,891	8,037	8,037	591	170	8,798	8,039	8,934	9,823	<b>10,414</b>	
	Hood Canal Portion	6,554	0											8,037	8,039	8,161	8,974	<b>9,513</b>	
	E. Strait Portion	761	0											761		773	849	<b>900</b>	

Note: Values in bold italics were estimated indirectly

**Reconstruction of the HC-SJF Summer Chum Salmon Runs**

**1980**

<b>Harvest</b>	17	0	773	18	156	2,912	4,281	1	0	0	6	97	474	980
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Mgmt Unit	Prod. Unit	Escape	Brood	***** Run Abundance by Location *****									Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN
				82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)				(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		17		34				55	86	86			86	86	86	89	94
12D	Tahuya	179			179	359				580	904	904			1,955	1,956	1,967	2,021	2,133
	Union	208			208	417				674	1,050	1,051							
12A	L. Quilcene	154						198	319	498	498				1,770	1,770	1,781	1,830	1,932
	B. Quilcene	375						393	505	815	1,271	1,271							
12-12B-12C	Big Beef	123								199	310	310			8,124	8,128	8,174	8,400	8,867
	Anderson	2								3	5	5							
	Dosewallips	1,216								1,963	3,061	3,061							
	Duckabush	827								1,335	2,082	2,082							
	Hamma	329								531	828	828							
	Lilliwaup	247				496				800	1,247	1,248							
	Dewatto	117				235				379	591	591							
Discovery	Snow	709											709		3,783		3,804	3,910	4,127
	Salmon	3,074											3,074						
Sequim	JCL	<b>1,326</b>												1,326	1,326		1,334	1,371	1,447
<b>Totals</b>		8,886	0	17	387	1,541	393	703	7,653	11,933	11,934	3,783	1,326	17,043	11,940	17,146	17,621	<b>18,600</b>	
	Hood Canal Portion	3,777	0											11,934	11,940	12,008	12,340	<b>13,026</b>	
	E. Strait Portion	5,109	0											5,109		5,138	5,281	<b>5,574</b>	

Note: Values in bold italics were estimated indirectly

**1981**

<b>Harvest</b>	116	0	158	2	137	466	1,294	3	0	0	6	63	597	915
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Mgmt Unit	Prod. Unit	Escape	Brood	***** Run Abundance by Location *****									Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN
				82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)				(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		116		145				169	237	237			237	237	240	266	306
12D	Tahuya	140			140	175				204	286	286			369	370	374	415	477
	Union	41			41	51				60	84	84							
12A	L. Quilcene	84						135	158	221	221				589	590	597	662	761
	B. Quilcene	138						140	226	263	368	368							
12-12B-12C	Big Beef	90								105	147	147			3,354	3,359	3,398	3,766	4,331
	Anderson	1								1	2	2							
	Dosewallips	63								74	103	103							
	Duckabush	557								650	909	909							
	Hamma	926								1,081	1,511	1,512							
	Lilliwaup	293				366				428	598	598							
	Dewatto	41				51				60	84	84							
Discovery	Snow	242											242		681		689	764	878
	Salmon	439											439						
Sequim	JCL	<b>203</b>												203	203		205	227	261
<b>Totals</b>		3,258	0	116	181	789	140	361	3,253	4,547	4,550	681	203	5,434	4,556	5,502	6,099	<b>7,014</b>	
	Hood Canal Portion	2,374	0											4,550	4,556	4,609	5,108	<b>5,875</b>	
	E. Strait Portion	884	0											884		894	991	<b>1,139</b>	

Note: Values in bold italics were estimated indirectly

**Reconstruction of the HC-SJF Summer Chum Salmon Runs**

**1982**

<b>Harvest</b>		90	0	245	0	304	726	2,485	0	0	0	0	132	296	2,219			
		***** Run Abundance by Location *****										Seattle	Admiralty	U.S.	CDN			
<b>Mgmt Unit</b>	<b>Prod. Unit</b>	Escape	Brood	82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20
Skokomish	Skokomish	N/A		90		141			172	279	279			279	279	283	292	359
12D	Tahuya	86			86	135			164	267	267			743	743	753	777	956
	Union	<b>153</b>			153	240			293	476	476							
12A	L. Quilcene	125						260	318	516	516			1,161	1,161	1,177	1,215	1,494
	B. Quilcene	156					156	325	397	644	644							
12-12B-12C	Big Beef	0							0	0	0			4,291	4,291	4,352	4,490	5,522
	Anderson	<b>0</b>							0	0	0							
	Dosewallips	507							620	1,006	1,006							
	Duckabush	690							844	1,369	1,369							
	Hamma	801							979	1,589	1,589							
	Lilliwaup	84				131			161	261	261							
	Dewatto	21				33			40	65	65							
Discovery	Snow	766										766		2,152			2,183	2,252
	Salmon	1,386										1,386						2,769
Sequim	JCL	599											599	599		608	627	771
<b>Totals</b>		5,374	0	90	239	679	156	585	3,988	6,473	6,473	2,152	599	9,224	6,473	9,356	9,652	11,871
	Hood Canal Portion	2,623	0											6,473	6,473	6,566	6,774	8,331
	E. Strait Portion	2,751	0											2,751		2,790	2,879	3,540

Note: Values in bold italics were estimated indirectly

**1983**

<b>Harvest</b>		23	0	209	276	1,131	105	664	9	0	0	2	131	146	28			
		***** Run Abundance by Location *****										Seattle	Admiralty	U.S.	CDN			
<b>Mgmt Unit</b>	<b>Prod. Unit</b>	Escapement	Brood	82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20
Skokomish	Skokomish	N/A		23		38			40	50	50			50	50	52	53	54
12D	Tahuya	86			86	144			150	187	188			559	559	575	594	597
	Union	170			170	284			296	370	371							
12A	L. Quilcene	176						537	559	699	701			2,199	2,200	2,265	2,337	2,351
	B. Quilcene	100					376	1,146	1,194	1,494	1,498							
12-12B-12C	Big Beef	0							0	0	0			508	509	524	540	543
	Anderson	0							0	0	0							
	Dosewallips	64							67	83	84							
	Duckabush	80							83	104	105							
	Hamma	190							198	248	248							
	Lilliwaup	18				30			31	39	39							
	Dewatto	15				25			26	33	33							
Discovery	Snow	154										154		885			911	940
	Salmon	731										731						946
Sequim	JCL	254											254	254		261	270	271
<b>Totals</b>		2,038	0	23	256	521	376	1,683	2,643	3,307	3,316	885	254	4,455	3,318	4,588	4,734	4,762
	Hood Canal Portion	899	0											3,316	3,318	3,416	3,524	3,545
	E. Strait Portion	1,139	0											1,139		1,172	1,210	1,217

Reconstruction of the HC-SJF Summer Chum Salmon Runs

1984

<b>Harvest</b>	70	0	80	75	902	113	458	2	0	0	5	3	65	314
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Mgmt Unit	Prod. Unit	Escape	***** Run Abundance by Location *****										Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN
			Brood	82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)				(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		70		79				82	96	97				97	97	98	105
12D	Tahuya	142			142	160				167	196	196				463	464	471	502
	Union	194			194	218				228	267	268							
12A	L. Quilcene	83						426	445	522	522				1,372	1,374	1,375	1,394	1,486
	B. Quilcene	60					135	694	724	849	850								
12-12B-12C	Big Beef	22								23	27	27				1,181	1,183	1,184	1,200
	Anderson	1								1	1	1							
	Dosewallips	212								221	260	260							
	Duckabush	299								312	366	366							
	Hamma	<b>170</b>								178	208	208							
	Lilliwaup	187				210				220	258	258							
	Dewatto	44				50				52	61	61							
Discovery	Snow	384											384		1,212			1,230	1,311
	Salmon	828											828				1,213		
Sequim	JCL	367												367	367		367	372	397
<b>Totals</b>		2,993	0	70	336	717	135	1,120	2,654	3,111	3,113	1,212	367	4,692	3,118	4,700	4,765	<b>5,079</b>	
	Hood Canal Portion	1,414	0											3,113	3,118	3,120	3,163	<b>3,372</b>	
	E. Strait Portion	1,579	0											1,579	1,580	1,602	1,602	<b>1,707</b>	

Note: Values in bold italics were estimated indirectly

1985

<b>Harvest</b>	70	0	56	40	274	288	648	10	0	0	2	40	445	1,620
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Mgmt Unit	Prod. Unit	Escape	***** Run Abundance by Location *****										Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN
			Brood	82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)				(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		70		76				90	122	123				123	123	125	145
12D	Tahuya	122			122	133				157	213	214				799	800	811	942
	Union	334			334	363				431	583	585							
12A	L. Quilcene	1						4	5	7	7				578	579	587	682	1,025
	B. Quilcene	44					84	355	421	569	571								
12-12B-12C	Big Beef	0								0	0	0				995	996	1,011	1,173
	Anderson	0								0	0	0							
	Dosewallips	236								280	379	380							
	Duckabush	30								36	48	48							
	Hamma	<b>231</b>								274	371	372							
	Lilliwaup	92				100				119	161	161							
Discovery	Snow	20											20		171			174	201
	Salmon	151											151						303
Sequim	JCL	61												61	61		62	72	108
<b>Totals</b>		1,341	0	70	456	693	84	359	1,837	2,485	2,495	171	61	2,727	2,497	2,769	3,215	<b>4,835</b>	
	Hood Canal Portion	1,109	0											2,495	2,497	2,534	2,941	<b>4,424</b>	
	E. Strait Portion	232	0											232	235	273	273	<b>411</b>	

Note: Values in bold italics were estimated indirectly

**Reconstruction of the HC-SJF Summer Chum Salmon Runs**

<b>1986</b>	<b>Harvest</b>	26	0	55	21	561	1,348	2,432	4	0	0	0	21	146	796
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Mgmt Unit	Prod. Unit	Escape	***** Run Abundance by Location *****											Seattle	Admiralty	U.S.	CDN		
			Brood	82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		26		27			38	58	58			58	58	58	59	65	
12D	Tahuya	109			109	112			159	243	243			4,468	4,468	4,480	4,561	5,001	
	Union	1,892			1,892	1,941			2,754	4,222	4,225								
12A	L. Quilcene	12						154	218	334	335			1,325	1,325	1,328	1,352	1,483	
	B. Quilcene	15						36	455	645	990	990							
12-12B-12C	Big Beef	0							0	0	0			1,147	1,147	1,150	1,171	1,284	
	Anderson	0							0	0	0								
	Dosewallips	57							81	124	124								
	Duckabush	177							251	385	385								
	Hamma	173							246	376	377								
	Lilliwaup	97				99			141	216	217								
	Dewatto	20				21			29	45	45								
Discovery	Snow	213											213		795				
	Salmon	582											582						
Sequim	JCL	292												292	292		293	298	327
<b>Totals</b>		3,639	0	26	2,001	2,199	36	609	4,563	6,995	6,999	795	292	8,086	6,999	8,107	8,253	9,049	
	Hood Canal Portion	2,552	0											6,999	6,999	7,017	7,143	7,832	
	E. Strait Portion	1,087	0											1,087		1,090	1,109	1,217	

<b>1987</b>	<b>Harvest</b>	39	0	56	3	1,603	302	860	4	0	0	0	0	147	390
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Mgmt Unit	Prod. Unit	Escape	***** Run Abundance by Location *****											Seattle	Admiralty	U.S.	CDN		
			Brood	82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		39		43			48	63	63			63	63	63	64	69	
12D	Tahuya	91			91	99			111	145	145			940	940	940	965	1,030	
	Union	497			497	539			605	794	795								
12A	L. Quilcene	71						1,459	1,638	2,149	2,151			2,484	2,484	2,484	2,549	2,722	
	B. Quilcene	8						11	226	254	333	333							
12-12B-12C	Big Beef	6							7	9	9			137	137	137	141	150	
	Anderson	0							0	0	0								
	Dosewallips	9							10	13	13								
	Duckabush	12							13	18	18								
	Hamma	26							29	38	38								
	Lilliwaup	32				35			39	51	51								
	Dewatto	5				5			6	8	8								
Discovery	Snow	465											465		1,527				
	Salmon	1,062											1,062						
Sequim	JCL	464												464	464		464	476	508
<b>Totals</b>		2,748	0	39	588	720	11	1,685	2,760	3,620	3,624	1,527	464	5,615	3,624	5,615	5,762	6,152	
	Hood Canal Portion	757	0											3,624	3,624	3,624	3,719	3,971	
	E. Strait Portion	1,991	0											1,991		1,991	2,043	2,181	

**Reconstruction of the HC-SJF Summer Chum Salmon Runs**

<b>1988</b>	<b>Harvest</b>	29	0	30	13	1,897	93	30	12	0	0	5	0	305	738
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Mgmt Unit	Prod. Unit	Escape	***** Run Abundance by Location *****										Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN	
			Brood	82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)				(Area 9)	Conv.	Area 20		
Skokomish	Skokomish	N/A		29		30				30		30			30		30	30	31	34
12D	Tahuya	145			145	149				152	153	153			817		818	818	846	915
	Union	629			629	646				658	662	664								
12A	L. Quilcene	177						1,259		1,283	1,291	1,294			2,268		2,270	2,270	2,349	2,540
	B. Quilcene	120					133	948		966	972	974								
12-12B-12C	Big Beef	0								0	0	0			1,956		1,958	1,958	2,026	2,191
	Anderson	0								0	0	0								
	Dosewallips	661								673	677	679								
	Duckabush	497								506	509	511								
	Hamma	440								448	451	452								
	Lilliwaup	275				282				288	290	290								
	Dewatto	23				24				24	24	24								
Discovery	Snow	723											723		2,638			2,638	2,730	2,952
	Salmon	1,915											1,915							
Sequim	JCL	1,052												1,052	1,052			1,052	1,089	1,177
<b>Totals</b>		6,657	0	29	774	1,131	133	2,207	5,029	5,059	5,071	2,638	1,052	8,761	5,076	8,766	9,071	9,809		
	Hood Canal Portion	2,967	0											5,071	5,076	5,076	5,253	5,680		
	E. Strait Portion	3,690	0											3,690		3,690	3,818	4,129		

<b>1989</b>	<b>Harvest</b>	16	0	49	27	339	607	536	11	0	0	1	4	421	2,273
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Mgmt Unit	Prod. Unit	Escape	***** Run Abundance by Location *****										Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN	
			Brood	82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)				(Area 9)	Conv.	Area 20		
Skokomish	Skokomish	N/A		16		17				27	36	37			37		37	37	43	75
12D	Tahuya	9			9	10				16	21	21			1,065		1,066	1,067	1,242	2,184
	Union	450			450	492				783	1,039	1,044								
12A	L. Quilcene	1						13		20	27	27			780		780	782	909	1,599
	B. Quilcene	1					28	355		564	749	753								
12-12B-12C	Big Beef	0								0	0	0			300		300	300	349	614
	Anderson	0								0	0	0								
	Dosewallips	16								25	34	34								
	Duckabush	60								95	127	127								
	Hamma	16								25	34	34								
	Lilliwaup	43				47				75	99	100								
	Dewatto	2				2				3	5	5								
Discovery	Snow	21											21		215			215	251	441
	Salmon	194											194							
Sequim	JCL	173												173	173			173	202	355
<b>Totals</b>		986	0	16	459	569	28	368	1,635	2,171	2,182	215	173	2,570	2,183	2,575	2,995	5,268		
	Hood Canal Portion	598	0											2,182	2,183	2,186	2,543	4,473		
	E. Strait Portion	388	0											388		389	452	795		

**Reconstruction of the HC-SJF Summer Chum Salmon Runs**

<b>1990</b>	<b>Harvest</b>	51	0	43	29	307	36	48	67	0	0	0	0	45	696
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Mgmt Unit	Prod. Unit	Escape	***** Run Abundance by Location *****											Seattle	Admiralty	U.S.	CDN		
			Brood	82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		51		58				60	63	68			68	68	70	105	
12D	Tahuya	6			6	7				7	7	8			373	373	373	385	577
	Union	275			275	310				323	341	365							
12A	L. Quilcene	0						0		0	0	0			402	402	402	416	623
	B. Quilcene	6						35	342	356	375	402							
12-12B-12C	Big Beef	0								0	0	0			167	167	167	173	259
	Anderson	0								0	0	0							
	Dosewallips	8								8	9	9							
	Duckabush	42								44	46	49							
	Hamma	90								94	99	106							
	Lilliwaup	2				2				2	2	3							
	Dewatto	0				0				0	0	0							
Discovery	Snow	33											33		278		278	287	430
	Salmon	245											245						
Sequim	JCL	63												63	63		63	65	98
<b>Totals</b>		770	0	51	281	377	35	342	895	943	1,010	278	63	1,351	1,010	1,351	1,396	2,092	
	Hood Canal Portion	429	0											1,010	1,010	1,010	1,044	1,564	
	E. Strait Portion	341	0											341		341	352	528	

<b>1991</b>	<b>Harvest</b>	3	0	13	15	751	0	6	66	0	0	0	0	59	171	483
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Mgmt Unit	Prod. Unit	Escape	***** Run Abundance by Location *****											Seattle	Admiralty	U.S.	CDN		
			Brood	82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		3		3				3	3	3			3	3	4	5	
12D	Tahuya	5			5	5				5	5	5			233	233	241	262	321
	Union	208			208	218				218	219	228							
12A	L. Quilcene	1						13	13	13	13				855	855	881	958	1,174
	B. Quilcene	49						64	804	804	807	842							
12-12B-12C	Big Beef	0								0	0	0			510	510	526	571	700
	Anderson	0								0	0	0							
	Dosewallips	250								250	251	262							
	Duckabush	102								102	102	107							
	Hamma	71								71	71	74							
	Lilliwaup	30				31				31	32	33							
	Dewatto	31				32				32	33	34							
Discovery	Snow	12											12		184		190	206	253
	Salmon	172											172						
Sequim	JCL	125												125	125		129	140	172
<b>Totals</b>		1,056	0	3	213	290	64	816	1,529	1,535	1,601	184	125	1,910	1,601	1,969	2,140	2,624	
	Hood Canal Portion	747	0											1,601	1,601	1,651	1,794	2,199	
	E. Strait Portion	309	0											309		319	346	424	

**Reconstruction of the HC-SJF Summer Chum Salmon Runs**

<b>1992</b>	<b>Harvest</b>	3	0	0	5	199	0	0	8	0	0	1	44	84	980
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Mgmt Unit	Prod. Unit	Escape	***** Run Abundance by Location *****											Seattle	Admiralty	U.S.	CDN			
			Brood	82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20		
Skokomish	Skokomish	N/A		3		3			3		3			3		3		3	3	
12D	Tahuya	0			0	0			0	0	0			140		140		142	145	183
	Union	140			140	140			140	140	140									
12A	L. Quilcene	9						11	11	11	11			949		950		961	983	1,237
	B. Quilcene	320	414					739	935	935	935	938								
12-12B-12C	Big Beef	0								0	0	0			1,499		1,499	1,517	1,551	1,953
	Anderson	0								0	0	0								
	Dosewallips	655								655	655	657								
	Duckabush	617								617	617	619								
	Hamma	123								123	123	123								
	Lilliwaup	81	18			99				99	99	99								
	Dewatto	0				0				0	0	0								
Discovery	Snow	21											21		454			459	470	591
	Salmon	371	62										433							
Sequim	JCL	616												616	616			623	637	802
<b>Totals</b>		2,953	494	3	140	242	739	947	2,583	2,583	2,591	454	616	3,661	2,592	3,706	3,790	4,770		
	Hood Canal Portion	1,945	432											2,591	2,592	2,623	2,682	3,376		
	E. Strait Portion	1,008	62											1,070		1,083	1,107	1,394		

<b>1993</b>	<b>Harvest</b>	2	0	1	0	15	0	0	2	0	0	0	46	53	67
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Mgmt Unit	Prod. Unit	Escape	***** Run Abundance by Location *****											Seattle	Admiralty	U.S.	CDN			
			Brood	82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20		
Skokomish	Skokomish	N/A		2		2			2		2			2		2		2	2	2
12D	Tahuya	0			0	0			0	0	0			252		252		261	271	283
	Union	251			251	252			252	252	252									
12A	L. Quilcene	12						13	13	13	13			163		163		169	175	183
	B. Quilcene	97	39					136	150	150	150									
12-12B-12C	Big Beef	0								0	0	0			358		358	370	384	402
	Anderson	0								0	0	0								
	Dosewallips	105								105	105	105								
	Duckabush	105								105	105	105								
	Hamma	69								69	69	69								
	Lilliwaup	67	10			77				77	77	77								
	Dewatto	1				1				1	1	1								
Discovery	Snow	11											11		463			479	497	520
	Salmon	400	52										452							
Sequim	JCL	110												110	110			114	118	123
<b>Totals</b>		1,228	101	2	251	332	136	163	774	774	776	463	110	1,349	776	1,395	1,448	1,514		
	Hood Canal Portion	707	49											776	776	802	833	871		
	E. Strait Portion	521	52											573		592	615	643		

**Reconstruction of the HC-SJF Summer Chum Salmon Runs**

<b>1994</b>	<b>Harvest</b>	1	0	0	0	20	0	0	13	0	0	0	27	54	451
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Mgmt Unit	Prod. Unit	Escape	***** Run Abundance by Location *****											Seattle	Admiralty	U.S.	CDN		
			Brood	82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		1		1			1		1			1		1	1	1	1
12D	Tahuya	0			0	0			0	0	0			742		742	749	765	891
	Union	738			738	738			738	738	742								
12A	L. Quilcene	0						0	0	0	0			746		746	753	769	896
	B. Quilcene	349	373					722	742	742	742	746							
12-12B-12C	Big Beef	0								0	0	0			974		974	984	1,004
	Anderson	0								0	0	0							
	Dosewallips	225								225	225	226							
	Duckabush	263								263	263	264							
	Hamma	370								370	370	372							
	Lilliwaup	99	12			111				111	111	112							
	Dewatto	0				0				0	0	0							
Discovery	Snow	2											2		163		165	168	196
	Salmon	137	24										161						
Sequim	JCL	15												15	15		15	15	18
<b>Totals</b>		2,198	409	1	738	850	722	742	2,450	2,450	2,463	163	15	2,641	2,463	2,668	2,722	3,173	
	Hood Canal Portion	2,044	385											2,463	2,463	2,488	2,538	2,959	
	E. Strait Portion	154	24											178		180	183	214	

<b>1995</b>	<b>Harvest</b>	0	0	0	0	7	0	0	32	0	0	0	0	0	68	458
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Mgmt Unit	Prod. Unit	Escape	***** Run Abundance by Location *****											Seattle	Admiralty	U.S.	CDN		
			Brood	82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		0		0			0		0			0		0	0	0	0
12D	Tahuya	0			0	0			0	0	0			723		723	723	728	760
	Union	721			721	721			721	721	723								
12A	L. Quilcene	54						54	54	54	54			4,596		4,596	4,596	4,627	4,830
	B. Quilcene	4,029	491					4,520	4,527	4,527	4,527	4,542							
12-12B-12C	Big Beef	0								0	0	0			4,181		4,181	4,209	4,394
	Anderson	0								0	0	0							
	Dosewallips	2,787								2,787	2,787	2,796							
	Duckabush	825								825	825	828							
	Hamma	476								476	476	478							
	Lilliwaup	79	0			79				79	79	79							
	Dewatto	0				0				0	0	0							
Discovery	Snow	25											25		616		616	620	647
	Salmon	538	53										591						
Sequim	JCL	223												223	223		223	224	234
<b>Totals</b>		9,757	544	0	721	800	4,520	4,581	9,469	9,469	9,501	616	223	10,340	9,501	10,340	10,408	10,866	
	Hood Canal Portion	8,971	491											9,501	9,501	9,501	9,564	9,984	
	E. Strait Portion	786	53											839		839	845	882	

**Reconstruction of the HC-SJF Summer Chum Salmon Runs**

<b>1996</b>	<b>Harvest</b>	9	0	0	0	51	24	24	40	0	0	0	23	80	338
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Mgmt Unit	Prod. Unit	Escape	Brood	***** Run Abundance by Location *****										Seattle	Admiralty	U.S.	CDN	
				82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20
Skokomish	Skokomish	N/A		9		9			9	9	9			9	9	9	9	9
12D	Tahuya	5			5	5			5	5	5			501	501	502	503	511
	Union	494			494	494			495	495	496							
12A	L. Quilcene	265						266	267	267	268			9,606	9,606	9,617	9,652	9,801
	B. Quilcene	8,479	771					9,250	9,300	9,310	9,321	9,339						
12-12B-12C	Big Beef	0							0	0	0			10,520	10,520	10,531	10,570	10,734
	Anderson	0							0	0	0							
	Dosewallips	6,976							6,984	6,992	7,006							
	Duckabush	2,650							2,653	2,656	2,661							
	Hamma	774							775	776	777							
	Lilliwaup	64	12			76			76	76	76							
	Dewatto	0				0			0	0	0							
Discovery	Snow	160											160		1,054		1,055	1,059
	Salmon	785	109										894					
Sequim	JCL	30											30	30		30	30	31
<b>Totals</b>		20,682	892	9	499	584	9,250	9,566	20,573	20,597	20,637	1,054	30	21,721	20,637	21,744	21,824	22,162
	Hood Canal Portion	19,707	783											20,637	20,637	20,659	20,735	21,056
	E. Strait Portion	975	109											1,084		1,085	1,089	1,106

<b>1997</b>	<b>Harvest</b>	0	0	77	0	100	3	0	0	0	0	0	0	0	0	46	198
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Mgmt Unit	Prod. Unit	Escape	Brood	***** Run Abundance by Location *****										Seattle	Admiralty	U.S.	CDN	
				82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim	Terminal	(Area 10)	(Area 9)	Conv.	Area 20
Skokomish	Skokomish	N/A		0		0			0	0	0			0	0	0	0	0
12D	Tahuya	0			0	0			0	0	0			481	481	481	484	493
	Union	410			410	481			481	481	481							
12A	L. Quilcene	29						29	29	29	29			8,006	8,006	8,006	8,042	8,199
	B. Quilcene	7,339	535					7,874	7,974	7,976	7,976	7,976						
12-12B-12C	Big Beef	0							0	0	0			665	665	665	668	681
	Anderson	0							0	0	0							
	Dosewallips	47							47	47	47							
	Duckabush	475							475	475	475							
	Hamma	104							104	104	104							
	Lilliwaup	9	18			32			32	32	32							
	Dewatto	6				7			7	7	7							
Discovery	Snow	67											67		901		901	905
	Salmon	724	110										834					923
Sequim	JCL	61											61	61		61	61	62
<b>Totals</b>		9,271	663	0	410	520	7,874	8,003	9,152	9,152	9,152	901	61	10,114	9,152	10,114	10,160	10,358
	Hood Canal Portion	8,419	553											9,152	9,152	9,152	9,194	9,373
	E. Strait Portion	852	110											962		962	966	985

**Reconstruction of the HC-SJF Summer Chum Salmon Runs**

**1998**

<b>Harvest</b>	57	21	0	0	10	16	16	0	0	0	0	0	53	50	98
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Mgmt Unit	Prod. Unit	Escape	Brood	***** Run Abundance by Location *****									Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN
				82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)				(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		57		57				57	57	57		57	57	58	59	60	
12D	Tahuya	0			0	0				0	0	0		246	246	248	251	255	
	Union	223			244	244				245	246	246							
12A	L. Quilcene	265						266	267	268	268			3,086	3,086	3,117	3,145	3,201	
	B. Quilcene	2,244	544				2,788	2,797	2,808	2,818	2,818								
12-12B-12C	Big Beef	0								0	0	0		730	730	738	744	758	
	Anderson	0								0	0	0							
	Dosewallips	336							337	339	339								
	Duckabush	226							227	228	228								
	Hamma	95	32						127	128	128								
	Lilliwaup	3	21			24			24	24	24								
	Dewatto	12				12			12	12	12								
Discovery	Snow	27										27		1,171		1,183	1,193	1,215	
	Salmon	1,023	121									1,144							
Sequim	JCL	98											98	98		99	100	102	
<b>Totals</b>		4,552	718	57	244	337	2,788	3,063	4,105	4,120	4,120	1,171	98	5,389	4,120	5,442	5,492	5,590	
	Hood Canal Portion	3,404	597											4,120	4,120	4,161	4,199	4,274	
	E. Strait Portion	1,148	121											1,269		1,282	1,293	1,316	

**1999**

<b>Harvest</b>	20	0	0	28	10	161	161	0	0	0	0	0	8	5	24
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Mgmt Unit	Prod. Unit	Escape	Brood	***** Run Abundance by Location *****									Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN
				82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)				(Area 9)	Conv.	Area 20	
Skokomish	Skokomish	N/A		20		20				20	21	21		21	21	21	21	21	
12D	Tahuya	1			1	1				1	1	1		172	172	173	173	174	
	Union	159			159	159				165	171	171							
12A	L. Quilcene	84						84	88	91	91			3,528	3,528	3,533	3,537	3,554	
	B. Quilcene	2,981	172				3,181	3,191	3,314	3,437	3,437								
12-12B-12C	Big Beef	0	4							4	4	4		772	772	774	774	778	
	Anderson	0								0	0	0							
	Dosewallips	351							365	378	378								
	Duckabush	92							96	99	99								
	Hamma	212	43						265	275	275								
	Lilliwaup	0	13			13			14	14	14								
	Dewatto	2				2			2	2	2								
Chimacum	Chimacum	38												38		38	38	38	
Discovery	Snow	29										29		528		529	529	532	
	Salmon	434	65									499							
Sequim	JCL	1	6										7	7		7	7	7	
<b>Totals</b>		4,384	303	20	160	195	3,181	3,275	4,333	4,494	4,494	528	7	5,067	4,494	5,075	5,079	5,104	
	Hood Canal Portion	3,882	232											4,494	4,494	4,501	4,505	4,527	
	E. Strait Portion	502	71											573		574	574	577	

**Reconstruction of the HC-SJF Summer Chum Salmon Runs**

**2000**

<b>Harvest</b>	9	0	0	0	707	52	52	0	0	0	1	1	13	27
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Mgmt Unit	Prod. Unit	Escape	Brood	***** Run Abundance by Location *****										Seattle (Area 10)	Admiralty (Area 9)	U.S. Conv.	CDN Area 20		
				82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim					Terminal	
Skokomish	Skokomish	N/A		9		9				9	9	9			9	9	9	9	
12D	Tahuya	2			2	2				2	2	2			754	754	754	755	757
	Union	682	62		744	744				748	752	752							
12A	L. Quilcene	268							300	302	303	303			6,678	6,678	6,679	6,687	6,704
	B. Quilcene	5,126	504					5,630	6,305	6,340	6,374	6,374							
12-12B-12C	Big Beef	0	20							20	20	20			2,027	2,027	2,027	2,030	2,035
	Anderson	0								0	0	0							
	Dosewallips	1,260								1,267	1,274	1,274							
	Duckabush	464								467	469	469							
	Hamma	173	56							230	232	232							
	Lilliwaup	2	20							22	22	22							
	Dewatto	10				10				10	10	10							
Chimacum	Chimacum	52													52		52	52	52
Discovery	Snow	30													30		876	876	877
	Salmon	710	136												846				
Sequim	JCL	9	46													55	55	55	55

<b>Totals</b>		8,788	844	9	746	787	5,630	6,605	9,417	9,468	9,468	876	55	10,451	9,469	10,453	10,466	10,493
	Hood Canal Portion	7,987	662											9,468	9,469	9,470	9,482	9,506
	E. Strait Portion	801	182											983	983	984	987	987

**2001**

<b>Harvest</b>	12	0	0	59	1,036	62	62	0	0	0	10	18	36	65
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Mgmt Unit	Prod. Unit	Escape	Brood	***** Run Abundance by Location *****										Seattle (Area 10)	Admiralty (Area 9)	U.S. Conv.	CDN Area 20		
				82G/J	12D	12C	82F	12A	12B	12	9A	Discov.	Sequim					Terminal	
Skokomish	Skokomish	3		15		15				15	15	15			15	15	15	15	15
12D	Tahuya	0			0	0				0	0	0			1,505	1,506	1,508	1,511	1,516
	Union	1,426	65		1,491	1,491				1,498	1,505	1,505							
12A	L. Quilcene	199							231	232	233	233			7,538	7,544	7,551	7,567	7,595
	B. Quilcene	5,868	306					6,233	7,237	7,271	7,305	7,305							
12-12B-12C	Big Beef	826	68							898	902	902			4,216	4,219	4,224	4,232	4,248
	Anderson	0								0	0	0							
	Dosewallips	990								995	999	999							
	Duckabush	942								946	951	951							
	Hamma	1,173	54							1,233	1,238	1,238							
	Lilliwaup	32	60			92				92	93	93							
	Dewatto	32				32				32	32	32							
Chimacum	Chimacum	903													903		904	906	909
Discovery	Snow	154													154		2,792	2,795	2,801
	Salmon	2,484	154												2,638				
Sequim	JCL	192	68													260	260	260	262

<b>Totals</b>		15,224	775	15	1,491	1,630	6,233	7,468	13,213	13,274	13,274	2,792	260	17,229	13,284	17,257	17,292	17,357
	Hood Canal Portion	11,491	553											13,274	13,284	13,297	13,325	13,375
	E. Strait Portion	3,733	222											3,955	3,959	3,967	3,982	3,982

**Reconstruction of the HC-SJF Summer Chum Salmon Runs**

**2002**

<b>Harvest</b>	0	0	0	0	1,437	0	214	0	0	0	0	0	0	0	0	0	30	41
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Mgmt Unit	Prod. Unit	Escape	Brood	***** Run Abundance by Location *****										Discov.	Sequim	Terminal	Seattle	Admiralty	U.S.	CDN
				82G/J	12D	12C	82F	12A	12B	12	9A	(Area 10)	(Area 9)				Conv.	Area 20		
Skokomish	Skokomish	0		0		0				0	0	0			0		0	0	0	0
12D	Tahuya	0			0	0				0	0	0			886		886	886	888	890
	Union	807	65			872	872			872	886	886								
12A	L. Quilcene	470							621	621	631	631			6,022		6,022	6,022	6,031	6,044
	B. Quilcene	3,662	355					4,017	5,303	5,303	5,392	5,392								
12-12B-12C	Big Beef	677	65							742	754	754			6,196		6,196	6,196	6,206	6,218
	Anderson	0								0	0	0								
	Dosewallips	1,627								1,627	1,654	1,654								
	Duckabush	530								530	539	539								
	Hamma	2,260	68							2,328	2,367	2,367								
	Lilliwaup	775	83				858			858	872	872								
	Dewatto	10				10				10	10	10								
Chimacum	Chimacum	864													864		864	865	867	
Discovery	Snow	532											532		6,049		6,049	6,058	6,070	
	Salmon	5,389	128										5,517							
Sequim	JCL	6	36											42	42		42	42	42	42
<b>Totals</b>		17,609	800		0	872	1,740	4,017	5,924	12,891	13,105	13,105	6,049	42	20,060	13,105	20,060	20,090	20,131	20,131
	Hood Canal Portion	10,818	636												13,105	13,105	13,105	13,125	13,151	13,151
	E. Strait Portion	6,791	164												6,955	6,955	6,955	6,966	6,980	6,980

# **APPENDIX REPORT 3**

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## ***AN ANALYSIS OF THE GENETIC CHARACTERISTICS AND INTERRELATIONSHIPS OF SUMMER CHUM IN HOOD CANAL AND STRAIT OF JUAN DE FUCA AND OF CHUM IN CURLEY CREEK (PUGET SOUND) USING ALLOZYME DATA***

**Todd Kassler and Jim Shaklee  
Washington Department of Fish and Wildlife**

**MAY, 2003**

## **Abstract**

Summer-run chum in the Strait of Juan de Fuca and Hood Canal have been previously identified by allozyme analysis as distinct from each other and from other chum salmon in Puget Sound. By 1989, summer chum salmon in the Strait of Juan de Fuca and Hood Canal had experienced a serious decline and were at their lowest known level. Concern over this decline prompted biologists from WDFW and the Point No Point Tribes to develop the Summer Chum Salmon Conservation Initiative (SCSCI) for chum in the Strait of Juan de Fuca and Hood Canal. One objective of this recovery plan was to begin supplementation programs for stocks at risk of extinction, and to monitor the effects that the supplementation program would have on the native stocks. Samples of chum from the Strait of Juan de Fuca and Hood Canal have been collected since 1985 for use in genetic analyses to establish baseline allele frequencies for populations in the major tributaries.

The analyses in this report examined recently collected allozyme data for summer chum populations in Hood Canal and the Strait of Juan de Fuca and compared the new data with previously collected allozyme data in a comprehensive and consistent analytical manner. A total of 43 collections from 12 locations in the Strait of Juan de Fuca and Hood Canal were statistically analyzed to assess population interrelationships and to see if the allele frequencies of any of the populations had changed over time. Assessment of the three locations sampled in the Strait of Juan de Fuca and nine locations sampled in Hood Canal supported the conclusion that these currently recognized summer chum stocks are significantly different from each other. Within Hood Canal, the Union River population was the most diverged, followed by the Lilliwaup River, and Dosewallips River populations. Only one population – Dosewallips River – showed a significant difference between collections (1992 vs 1998). The 1992 collection from Dosewallips River was significantly different from all other Hood Canal collections (except Lilliwaup) whereas the 1998 collection from Dosewallips River was not significantly different from any other Hood Canal collection (except Union and Lilliwaup). There are several possible causes for the significant difference in the Dosewallips collections for 1992 and 1998: 1) the allele frequencies in the 1998 Dosewallips collections may simply be more similar to the other Hood Canal collections than they were to the 1992 Dosewallips collection and reflect the natural variability between years within summer chum in the Dosewallips River; 2) chum may have strayed from the Quilcene stock supplementation program into the Dosewallips River in 1998, been included in the collection, and contributed to this change of distinctiveness; 3) differences in samples sizes for the 1992 (N=100) and 1998 (N=50) collections may influence how significantly different the Dosewallips

collections are from other Hood Canal samples; or 4) the differences may reflect a change in the effective population size of spawning adults that produced the 1992 and 1998 returning summer chum. The underlying cause for the observed difference between the 1992 and 1998 Dosewallips collections will remain unclear until additional collections of at least 100 individuals from multiple years are analyzed to determine if natural cycles in the summer chum run into Dosewallips can explain the difference or if straying of summer chum from Quilcene is likely contributing to any differences.

A collection of early-timed chum from Curley Creek (Colvos Passage – Puget Sound) was electrophoretically characterized and statistically compared to various summer and fall-timed Puget Sound stocks as well as summer and fall-timed Hood Canal stocks and summer-timed Strait of Juan de Fuca stocks to determine the genetic relationships of the Curley Creek population. These analyses showed that the early-timed chum in Curley Creek were quite similar genetically to summer-timed chum in Blackjack Creek. Pairwise tests were not significantly different between Blackjack Creek and Curley Creek whereas all tests of Curley Creek chum with collections of other Puget Sound summer (and fall) chum populations were significantly different.

Additional genetic analysis of summer chum salmon from Hood Canal and Strait of Juan de Fuca streams provides an opportunity to monitor changes in the genetic characteristics and genetic diversity of summer chum populations, including those affected by the ongoing summer chum supplementation programs. A collection of summer chum from Ollala Creek should be taken to compare to Curley Creek and Blackjack Creek to determine the geographic boundaries of this chum genetic diversity unit.

## Introduction

Chum salmon (*Oncorhynchus keta*) have been analyzed throughout the Pacific Northwest (Washington and Oregon, USA and southern British Columbia, Canada) to determine genetic relationships among populations (Phelps et al. 1994, Phelps et al. 1995, Johnson et al. 1997). These genetic relationships have been used to identify major ancestral lineages (MALs) and genetic diversity units (GDUs) of chum salmon in Washington (Phelps et al. 1995). NMFS expanded the analysis to include Oregon and British Columbia in the NMFS ESA status review of chum salmon (Johnson et al. 1997).

A genetic diversity unit (GDU) is a group of genetically similar stocks (or an individual stock) that is genetically distinct from other such groups. The stocks within a GDU typically exhibit similar life histories and occupy ecologically, geographically, and geologically similar habitats (Busack and Marshall 1995). A stock is a group of interbreeding individuals that is genetically distinct and substantially reproductively isolated from other such groups (Busack and Marshall 1995). The SASSI process (WDF et al. 1993) used three criteria to identify stocks: geographic isolation, temporal differences in run or spawn time, and genetic divergence. These three criteria were considered to be indicators of reproductive isolation. Knowledge of the number, characteristics, and geographic ranges of stocks and GDUs is important to the management and recovery of a species to ensure the genetic diversity within each GDU is being maintained.

A total of 14 distinct GDUs have been identified for chum salmon in Washington (Phelps et al. 1995). Seven of those GDUs are described for summer, fall, or winter run chum in Hood Canal, central and south Puget Sound, and Sequim and Discovery Bay (Strait of Juan de Fuca). Spawn time of summer chum occurs from September to October, fall chum from November to mid January, and winter chum spawn from mid January to March in Hood Canal populations (WDFW and PNPTT 2000).

Run sizes for summer chum in the Strait of Juan de Fuca and Hood Canal (combined) were above 10,000 fish from 1974 – 1980, however subsequent run sizes of chum in the Strait of Juan de Fuca and Hood Canal began to drop with all time lows occurring in 1990 and 1993 (WDFW and PNPTT 2001). In response to this decline, managers from the Washington Department of Fish and Wildlife (WDFW) and Point No Point Treaty Tribes (PNPTT) greatly restricted the number of chum that could be harvested to provide protection to summer chum in these fisheries.

Concern over the decline of summer chum led to the development of the Summer Chum Salmon Conservation Initiative (SCSCI) that was aimed to assist in the recovery of summer chum from Hood Canal and the Strait of Juan de Fuca (WDFW and PNPTT 2000) while protecting the genetic diversity of these stocks. Following conditions imposed by the SCSCI, WDFW, PNPTT, U.S. Fish and Wildlife Service (USFWS), and private citizen groups initiated summer chum hatchery supplementation programs to aid in the recovery of summer chum stocks determined to be at risk of extinction in the Strait of Juan de Fuca and Hood Canal.

The SCSCI document identified several objectives including an assessment of the affects that the supplementation program would have on the genetic character of natural populations and secondly, a program to monitor and evaluate any changes in the relationship of populations in the Strait of Juan de Fuca and Hood Canal to each other. These objectives have been addressed by sampling the major spawning populations in the Strait of Juan de Fuca and Hood Canal in 1985 and 1986 to provide a baseline genetic profile for each population. Each population was then re-sampled several times from 1985 – 2001 to determine if the genetic make-up of these populations has changed, possibly as a result of the supplementation program. Allozyme data have been used in this study to analyze the original collections and all subsequent collections to determine if or how much change has occurred in summer chum in the Strait of Juan de Fuca and Hood Canal.

A second portion of this report consists of the electrophoretic and statistical analysis of Curley Creek (Colvos Passage, Puget Sound) early-timed chum in relation to selected summer and fall chum from Puget Sound and summer chum from the Strait of Juan de Fuca, Hood Canal, the Fraser River, and the Strait of Georgia to evaluate the genetic characteristics of this population.

## **Methods**

### Collections

Samples of summer chum were collected from 12 locations in the Strait of Juan de Fuca and Hood Canal from 1985 – 2001 (Table 1, Figure 1). Collection dates are shown in Table 1 for verification of run time for each collection. The collection of chum salmon from Curley Creek (Colvos Passage - Puget Sound) occurred in 2002 by Suquamish Tribal biologists (Table 1). Data from several collections of summer and fall chum from Hood Canal, Puget Sound, Strait of Georgia, and the Fraser

River were included in the statistical analysis for comparative purposes. Muscle, heart, eye, and liver tissues were taken from all chum samples and stored in an ultrafreezer (-70°C) until analysis was conducted.

### Electrophoretic Methods

Tissues from all chum samples were analyzed using the protocol shown in Appendix 1 following the general methods described by Aebersold et al. (1987). Data collection at WDFW involved redundant screening of many loci using multiple tissues and/or buffer systems and independent, double scoring of all allozyme phenotypes. Samples having ambiguous scoring were either re-analyzed to obtain reliable scores or the ambiguous scores were omitted.

Allele mobilities for all loci scored in chum are shown in Appendix 2. Alleles that were not reliably scored were pooled with the most common allele that would have been scored. The MPI\*95 allele was pooled with the MPI\*92 allele and the ALAT\*103 allele was pooled with the ALAT\*105 allele for statistical analyses.

### Statistical Methods

Allele frequencies (Appendix 3) for all collections were calculated using WHICHRUN (version 4.1, Banks and Eichert 2000). Tests for conformance to Hardy Weinberg expectations were calculated using GENEPOP (version 3.3, Raymond and Rousset 1995) to determine if any loci should be excluded from subsequent analysis. Pairwise tests of genotypic differentiation of summer chum collections from the Strait of Juan de Fuca, Hood Canal, and Puget Sound collections were calculated using GENEPOP (version 3.3, Raymond and Rousset 1995). A non-sequential Bonferroni correction for multiple tests was used to correct alpha values to determine significance levels for the pairwise comparisons (Rice 1989) for both the Hardy Weinberg tests and pairwise tests. The Bonferroni correction is a conservative approach to determine significance levels versus identifying all P-values less than 0.05 as significant. Genetic distance matrices among all collections were generated using the program MSA (Microsatellite Analyzer, version 2.65, Dieringer and Schlötterer 2003) using Cavalli-Sforza and Edwards (1967) chord distance. The neighbor-joining method of Saitou and Nei (1987) and Consensus program in PHYLIP (version 3.5, Felsenstein 1989) were used to generate a dendrogram from the distance matrix calculated by MSA with 10,000 bootstrap replicates and without any bootstrap replication. The dendrogram generated in PHYLIP was plotted using TREEVIEW (version 1.6.6, Page 1996). Collections from the

Strait of Georgia and Fraser River were used as outgroup collections. The distance matrix calculated by MSA was used with the program NTSYS-pc (version 2.02j, Rohlf 1998) to conduct Principal Coordinates Analysis (PCA) and Multidimensional Scaling (MDS) analysis in two and three-dimensions.

Pairwise tests were conducted for the 43 individual collections of chum salmon from the Strait of Juan de Fuca and Hood Canal, for a subset of 25 collections/aggregated collections with sample sizes of 48 or greater, and for the 12 Strait of Juan de Fuca and Hood Canal populations. Pairwise tests were also run to compare chum in Curley Creek to other known summer chum in Puget Sound. A consensus tree from 10,000 neighbor-joining trees based on Cavalli-Sforza and Edwards (1967) pairwise genetics distances and multidimensional plots (two and three dimensions) were then generated for summer and fall collections of chum salmon in the Strait of Juan de Fuca, Hood Canal, Puget Sound, the Strait of Georgia, and the Fraser River.

## Results

A total of 22 enzyme systems were screened with a total of 47 loci (41 diploid loci and three isolocus pairs) being scored (Appendix 1). Twenty-four (two isolocus pairs) of the 47 loci were polymorphic, but only 15 loci (including both isolocus pairs) were used in the analyses: 13 loci were variable at the  $P_{0.95}$  level, two loci (*sIDHP-1* and *sMDHB-1,2*) at the  $P_{0.99}$  level, and the remaining nine loci were not used since they were polymorphic below the  $P_{0.99}$  level (Appendix 2).

Three loci (*sAAT-3\**, *ESTD-2\**, and *sIDHP-1\**) were excluded for the analysis of pairwise differentiation between chum salmon in the Strait of Juan de Fuca/Hood Canal and Puget Sound because of missing data for individual collections. The *sAAT-3\** locus was not used for the individual analysis of 43 collections in the Strait of Juan de Fuca/Hood Canal chum, but was used for all other analyses. The *ESTD-2\** locus was only used after the 43 individual collections from the Strait of Juan de Fuca/Hood Canal were combined into 12 populations. The *sIDHP-1\** locus was only used for the individual and combined analyses of Strait of Juan de Fuca/Hood Canal chum. The *ESTD-2\** and *sIDHP-1\** loci were also excluded for the analysis that generated the dendrogram and multidimensional plots.

## Hardy Weinberg Tests

Tests for conformance to Hardy Weinberg expectations revealed few significant deviations. Deviation for *G3PDH-2* occurred in the two collections from Quilcene National Fish Hatchery (1997) while deviation for *sMDH-A1* and *PEPB-I* occurred at one collection each (Big Beef Creek 2001 and Dosewallips River 1998, respectively). There was no deviation from Hardy Weinberg expectations for any loci in the Curley Creek or Puget Sound summer chum.

## Population Differentiation - Strait of Juan de Fuca/Hood Canal Populations

Pairwise tests of the 43 individual collections from the Strait of Juan de Fuca and Hood Canal revealed only one significant difference (Table 2). The 1992 and 1998 collections of chum salmon from Dosewallips River were significantly different. Pairwise tests were then run on the 1992 and 1998 collections from Dosewallips compared to the other collections in Hood Canal. The 1992 collection from Dosewallips was highly significantly different from all of the Hood Canal collections while the 1998 collection from Dosewallips was only significantly different from Union and Lilliwaup (data not shown).

Many of the 43 individual collections had small sample sizes that limited the statistical power of the analysis; therefore, those individual collections were combined with other collections from the same locality to increase sample sizes to 48 or greater. Pairwise tests run on these 25 collections/aggregated collections revealed significant differences between populations in the Strait of Juan de Fuca and populations in Hood Canal with three exceptions (Table 3): Snow Creek (1986) vs. Lilliwaup (1985 + 1986); Jimmycomelately (1986) vs. Hamma Hamma (2000); and Jimmycomelately (1986) vs. Duckabush (1985 + 1986). Aggregated collections from the Strait of Juan de Fuca revealed that Snow and Salmon were not significantly different. The Jimmycomelately (1986) collection was significantly different from the Salmon (1986) collection, but was not significantly different from Snow (1986) or Salmon (1997). The aggregated collection from Jimmycomelately (2000 + 2001), however, was significantly different from Salmon and Snow. Pairwise comparisons between Hood Canal collections/aggregate collections were heterogeneous, with many being non-significant (after correction for multiple tests) but others being significant. The Union River collections tended to be significantly different from Big Quilcene, Quilcene National Fish Hatchery, Lilliwaup, and Dosewallips collections. While the Lilliwaup 1985+1986 aggregate collection was not significantly different from any other Hood Canal collections, the Lilliwaup 1992 collection and the Lilliwaup 1995+1997+2000 aggregate

collection were significantly different from the Duckabush 1992 collection (but not the Duckabush 1985+1986 aggregate) and from the Dosewallips 1992 collection (but not the Dosewallips 1998 collection). The Dosewallips 1992 collection was quite unusual in this analysis because it was significantly different from all other Hood Canal collections except for the Lilliwaup 1985+1986 aggregate collection. Nearly all of the other pairwise tests between Hood Canal collections/collection aggregates in this data set were not significant after correction for multiple tests indicating no clear patterns of change in allele frequencies. Several localities that were not statistically different when the earliest collections were tested were statistically different when the most recent collections were tested.

Pairwise tests were then run for the 12 populations of chum from the Strait of Juan de Fuca and Hood Canal (defined by locality) revealing highly significant differences between the three populations from the Strait of Juan de Fuca and the nine populations from Hood Canal (Table 4). Two of the populations from the Strait of Juan de Fuca (Salmon Creek and Snow Creek;  $P = 0.25356$ ) were not significantly different from each other; however the third population (Jimmycomelately) was significantly different from both of them. One population from Hood Canal (Union River) was significantly different from all other populations in Hood Canal while the Lilliwaup and Dosewallips populations were significantly different from all but one population (Little Quilcene River and Big Beef, respectively). The sample size from Little Quilcene ( $N=30$ ) was low and therefore tests involving this collection had low power, perhaps explaining why this population was not significantly different from any other Hood Canal population except Union.

#### Population Differentiation – Curley Creek and Puget Sound summer chum

Pairwise tests for summer chum in Puget Sound did not reveal any significant differences between any of the yearly collections at a location (Table 5). The results did reveal that Curley Creek and Blackjack Creek (not significantly different from each other) were significantly different from all other Puget Sound chum. The two collections from Johns Creek were significantly different from the 1985 collection from Sherwood Creek, however the 1994 collection from Sherwood Creek was only significantly different from the 1985 collection from Johns Creek (Table 5). All other pairwise tests of Puget Sound summer chum were not significant.

## Clustering Analysis

The consensus neighbor-joining tree generated using Cavalli-Sforza and Edwards (1967) distances revealed five major cluster groups (Figure 2). The Canadian collections from the Fraser River and the Strait of Georgia clustered as a unique group with bootstrap support of 83%. The next two clusters included the populations of summer chum from Hood Canal and the Strait of Juan de Fuca. Within this cluster the three populations from the Strait of Juan de Fuca were separated from the Hood Canal populations with 76% bootstrap support. The separation of Jimmycomelately Creek from Snow and Salmon Creek had bootstrap support of 76%. The last two clusters included summer and fall collections from Puget Sound. The first group included collections that were from Colvos Passage and Sinclair Inlet (Curley Creek and Blackjack Creek). The cluster of Curley Creek with Blackjack Creek had bootstrap support of 75%; however the positioning of the Blackjack Creek and Curley Creek cluster to the other Puget Sound collections had very low bootstrap support. The remaining populations cluster together with low bootstrap support and are grouped together.

Two- and three-dimensional MDS plots (figures 3 and 4, respectively) revealed four major groups of collections. Stress levels for the multi-dimensional scaling analysis indicated a “fair” fit in two dimensions and a “good” fit in three dimensions. The Canadian collections were separated from the other groups by the MDS analysis. The summer chum in the Strait of Juan de Fuca and Hood Canal were distinct and, therefore identified as two separate groups. The remaining collections, summer and fall collections from Puget Sound, formed a relatively homogenous cloud of points and were considered to represent a fourth group.

## **Discussion**

Genetic characterization of Pacific salmon stocks in the Northwest is an important component of defining population structure and monitoring genetic diversity of existing stocks as we seek to protect and maintain these valuable natural resources. State agencies have the task of providing management plans that allow for both a sustainable and harvestable resource, while also protecting the individual genetic stocks and GDUs. The Summer Chum Salmon Conservation Initiative (SCSCI) has outlined a recovery plan for summer chum salmon in the Strait of Juan de Fuca and Hood Canal that has addressed both of these issues (WDFW and PNPTT 2000).

## Comparison of the Present Analysis to Past Analyses

The analysis in this report was undertaken to 1) examine recently collected genetic data for Hood Canal and Strait of Juan de Fuca summer chum populations, 2) re-analyze previously collected data, and 3) compare the new data with the previously collected data in a comprehensive and consistent analytical manner. For example, in contrast to the earlier evaluations, all statistical testing for this report incorporated correction for multiple tests.

The genetic data analyzed in the current report includes some of the same data as previously analyzed in the 1992 SASSI report (WDFW and PNPTT 1993), Phelps et al. (1994), the GDU report (Phelps et al. 1995), and memos by LeClair (1998a, 1998b, and 1998c). However, each of these analyses used slightly different data sets and different approaches for analyzing the genetic data (in some cases different statistical tests were used and corrections for multiple testing were made in some cases and not in others). Thus, it is difficult and potentially misleading to make direct comparisons among the different studies without considering all of the underlying differences in approach and interpretation. We think some of the apparent differences regarding the interrelationships among Hood Canal summer chum populations stem from the fact that the SASSI, GDU, and SCSCI processes incorporated genetic and other characteristics (run-timing and other biological characteristics including geographic separation) in determining whether or not two populations should be considered distinct stocks whereas most of the other analyses considered only genetic characteristics (including those in this report). Additionally, some of the difference is attributable to the different approaches to evaluating the statistical significance of tests of population interrelationships using genetic data mentioned above.

The 1992 SASSI report recognized only two Hood Canal summer-run stocks: “Hood Canal” and “Union River”; however results from ongoing genetic studies indicate that there may be more than two summer chum stocks in Hood Canal. Recognition of the two stocks in the SASSI report was based on cumulative differences among these groups -- a 1-2 week run-timing difference, significant allozyme differences (21-locus G-tests), and the geographic separation of spawning -- but was constrained by the limited data (small sample sizes) for several localities that were available at the time.

The Phelps et al. (1994) study of Washington chum salmon documented significant genetic heterogeneity among five western Hood Canal summer chum populations (chi square test  $P < 0.0001$ ), but did not present or discuss the results of pairwise tests among these populations. Furthermore, these authors did not detect significant year-to-year variation in allele frequencies at two of these locations (when they compared collections taken from 1985 - 1992).

The 1995 chum GDU report (Phelps et al. 1995) summarized additional analyses of Hood Canal summer chum (and other populations, including Strait of Juan de Fuca summer chum). Three diversity components were recognized: 1) western Hood Canal populations, 2) Union River, and 3) eastern Hood Canal populations. However, the eastern Hood Canal component was considered extinct and there were no genetic data for any of these populations. While many of the pairwise comparisons (G-tests) among the various western Hood Canal populations summarized in the GDU report yielded P-values of less than 0.05, we believe that most of these test results would not be considered statistically significant if correction for multiple tests was applied. The Union River population was reported to be significantly different from the various western Hood Canal summer and fall chum populations (except for Hamma Hamma River summer chum) in the GDU report (whether or not it would have been considered significant after correction for multiple tests cannot be determined from the information presented in this report).

The analyses reported by LeClair (1998a, 1998c) were for direct pairwise tests for differences among various individual Hood Canal summer chum collections, however the pairwise G-tests values reported were not corrected for multiple tests. This analysis showed that allele frequencies for most localities did not differ significantly between years. In contrast, many pairwise tests yielded P-values of less than 0.05 and the majority of those had P-values of less than 0.001. Because the actual P-values were not reported, there is no way to know how many of the test results would have been considered significant after correction for multiple tests. The results of pairwise tests reported by LeClair (1998c) and distributional data was the basis for the list of stocks identified in the SCSCI report. Based on the standard of substantial reproductive isolation, the SCSCI report recognized six stocks of summer chum in Hood Canal (Union, Lilliwaup, Hamma Hamma, Duckabush, Dosewallips, and Big/Little Quilcene) and three summer chum stocks (Snow/Salmon, Jimmycomelately, and Dungeness) in the Strait of Juan de Fuca (WDFW and PNPTT 2000).

#### Analysis of summer chum in the Strait of Juan de Fuca and Hood Canal

Pairwise tests performed on yearly collections from each of the populations of summer chum salmon in the Strait of Juan de Fuca and Hood Canal taken from 1985 – 1997 revealed no significant differences (LeClair 1998a); therefore collections from the same population were combined. The same collections included in the earlier analysis were combined together with 15 additional collections taken from 1998 – 2001 to re-analyze the populations. Pairwise comparisons of all the new individual yearly

collections revealed only one significant difference - between the 1992 and 1998 collections from the Dosewallips River. There are several possible causes for the significant change in the Dosewallips collections from 1992 to 1998: 1) chum may have strayed from the Quilcene stock supplementation program into the Dosewallips River in 1998, been included in the collection, and contributed to this loss of distinctiveness, or 2) the allele frequencies in the 1998 Dosewallips collections may simply be more similar to the other Hood Canal collections than they were to the 1992 Dosewallips collection. The underlying cause for the observed difference between the 1992 and 1998 Dosewallips collections will remain unclear until additional collections from other years are analyzed to determine if natural cycles in the summer chum run into Dosewallips can explain the difference or if straying of summer chum from Quilcene is most likely.

Pairwise tests for the 25 aggregated collections were conducted to assess if there had been any significant divergence in allele frequencies over time, from the earliest collections (1985 and 1986) to the most recent collections. LeClair (1998a) had conducted an analysis using aggregated collections; however, the aggregate collections from that analysis were not all the same as used here. Comparison of aggregated collections from the Strait of Juan de Fuca to Hood Canal in this report revealed significant differences at all but three of the pairwise tests. The analysis by LeClair (1998a) did not include the P-values for the comparison of the Strait of Juan de Fuca and Hood Canal; therefore we cannot make a direct comparison between the analyses by LeClair and those that we did. The pairwise tests for the 1986 collection from Jimmycomelately Creek to the 1986 collection from Salmon Creek revealed these collections were not significantly different while the Jimmycomelately collections (2000 + 2001) were significantly different from Snow Creek and Salmon Creek indicating a change in the allele frequencies between Jimmycomelately Creek, Salmon Creek, and Snow Creek from the early collections to the most recent. The pairwise tests for the collections in Hood Canal do not reveal clear patterns of change in frequency. For example, several localities that were not statistically different when the earliest collections were tested were statistically different when the most recent collections were tested.

When the collections were combined by location to represent populations and were analyzed for pairwise differences, all but three of the comparisons were significant: Salmon (1986 + 1997) vs. Snow Creek (1986); Duckabush River (1985 + 1986 + 1992) vs. Hamma Hamma River (1985 + 1986 + 1994 + 1995 + 1997); and Quilcene Bay/River (1992 + 1993 + 1994) vs. Hamma Hamma River (1985 + 1986 + 1994 + 1995 + 1997). This outcome was consistent with that obtained previously by LeClair (1998c). In addition, there were some non-significant results from the Big Beef Creek and Little Quilcene

collections that had not been previously analyzed. Summer chum salmon in Big Beef Creek originated from the Quilcene National Fish Hatchery; therefore, it is not surprising to see similar allele frequencies in Big Beef Creek, Big Quilcene River/Bay, and Quilcene National Fish Hatchery. The collection from Little Quilcene was not significantly different from any other Hood Canal summer chum populations except Union River. However, there were only 30 fish in the Little Quilcene collection so that the power of these tests was limited.

Summer chum in the Strait of Juan de Fuca, Hood Canal, and Puget Sound were previously identified as genetically distinct from each other using UPGMA clustering analyses and multidimensional scaling analysis (Phelps et al. 1994, Phelps et al. 1995, Johnson et al. 1997, LeClair 1998a, LeClair 1998b). The present analysis used a neighbor-joining method and multidimensional scaling analysis to evaluate whether or not the interrelationships of chum in the Strait of Juan de Fuca, Hood Canal, and Puget Sound were basically the same as were seen in the previous analyses. Bootstrap values for the consensus neighbor-joining tree (Figure 2) and results for the pairwise tests (Table 4) support the conclusion that the collections from the Strait of Juan de Fuca and Hood Canal are distinct.

Previous analysis of summer chum in Hood Canal identified the 1993 collection from Union and the 1986 and 1992 collections from Dosewallips as the most divergent populations, while the Lilliwaup collections formed a cluster that was distinct from all other collections in Hood Canal (LeClair 1998a). There were only 27 fish in the 1993 Union collection; therefore the reliability of this result is low. The present analysis, which included 15 additional collections, revealed similar clustering patterns of summer chum in Hood Canal to the earlier analyses. In the present analysis, Union was the most distant while the other Hood Canal populations clustered together. Bootstrap values for the clustering patterns observed for the populations of Hood Canal summer chum were all below 70 (Figure 2), and therefore, the clustering patterns had little statistical support. Comparison of the consensus neighbor-joining tree (Figure 2) with the pairwise tests (Table 4), however, did provide support that aggregate collections for Union, Lilliwaup, and Dosewallips were each significantly different from all of the other populations of summer chum in Hood Canal.

We believe that the genetic data and analyses presented in this report (especially in Tables 3 and 4) provide evidence supporting the conclusion that the summer chum salmon populations in Union River, Lilliwaup River, Snow Creek + Salmon Creek, and Jimmycomelately Creek represent distinct stocks. The genetic data alone do not support or refute the identification of any other distinct summer chum stocks in Hood Canal.

### Analysis of chum in Curley Creek

Spawning ground surveys in Curley Creek and Ollala Creek (Colvos Passage) have revealed early-timed chum (September and October), but these populations have not been previously analyzed to determine if they were genetically similar to fall or summer run chum. A collection of chum from Curley Creek was therefore, statistically analyzed with collections of chum from known summer and fall run populations in Puget Sound, fall and summer run populations in Hood Canal, and four outgroups, fall-timed chum from the Strait of Georgia and the Fraser River, to answer this question.

The pairwise tests of summer chum in Puget Sound revealed a non-significant difference between Blackjack Creek and Curley Creek chum while significant differences were observed compared to other summer run chum in Puget Sound. Curley Creek is geographically close (approx. 9.5 miles) to Blackjack Creek; therefore it is not surprising that these two collections would be genetically similar. The consensus neighbor-joining tree clustered Curley Creek and Blackjack together but distant from the fall and summer collections of Puget Sound while the multidimensional scaling analysis placed the Curley Creek and Blackjack collections near each other and on the periphery of the Puget Sound Group. The pairwise tests and clustering analyses indicated that Blackjack Creek summer chum and Curley Creek were not closely associated with chum from either Puget Sound or Hood Canal, but were closely grouped together. This result is not surprising considering the analysis by Phelps et al. (1995) identified Blackjack Creek summer chum in its own GDU (no other Sinclair Inlet or Colvos Passage early-timed chum populations had been sampled at that time).

### Future Work/Additional Analyses

A project using microsatellite DNA markers is being conducted by WDFW on chum salmon in Hood Canal to establish baseline data for continued assessment of chum (Small and Young 2003). Preliminary results indicate that similar clustering patterns are being detected using microsatellites as have been detected with these allozyme analyses. We expect that WDFW will now collect tissue for DNA analysis only since benefits include potential for non-lethal sampling, increased resolution, and reduction in the time, effort, and cost to collect and store samples.

Additional genetic analysis of summer chum salmon from Hood Canal and Strait of Juan de Fuca streams provides an opportunity to monitor changes in the genetic characteristics and genetic diversity of summer chum populations, including those affected by the ongoing summer chum supplementation programs.

Additional collections of chum in Curley Creek, Blackjack Creek, and Ollala Creek will help to identify the geographic boundaries of the GDU that was originally identified by Phelps et al. (1995) for Blackjack summer chum.

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Figure 1. Map of Hood Canal.

▲ = Quilcene Natl. Fish Hatchery  
● = Hood Canal Fish Hatchery

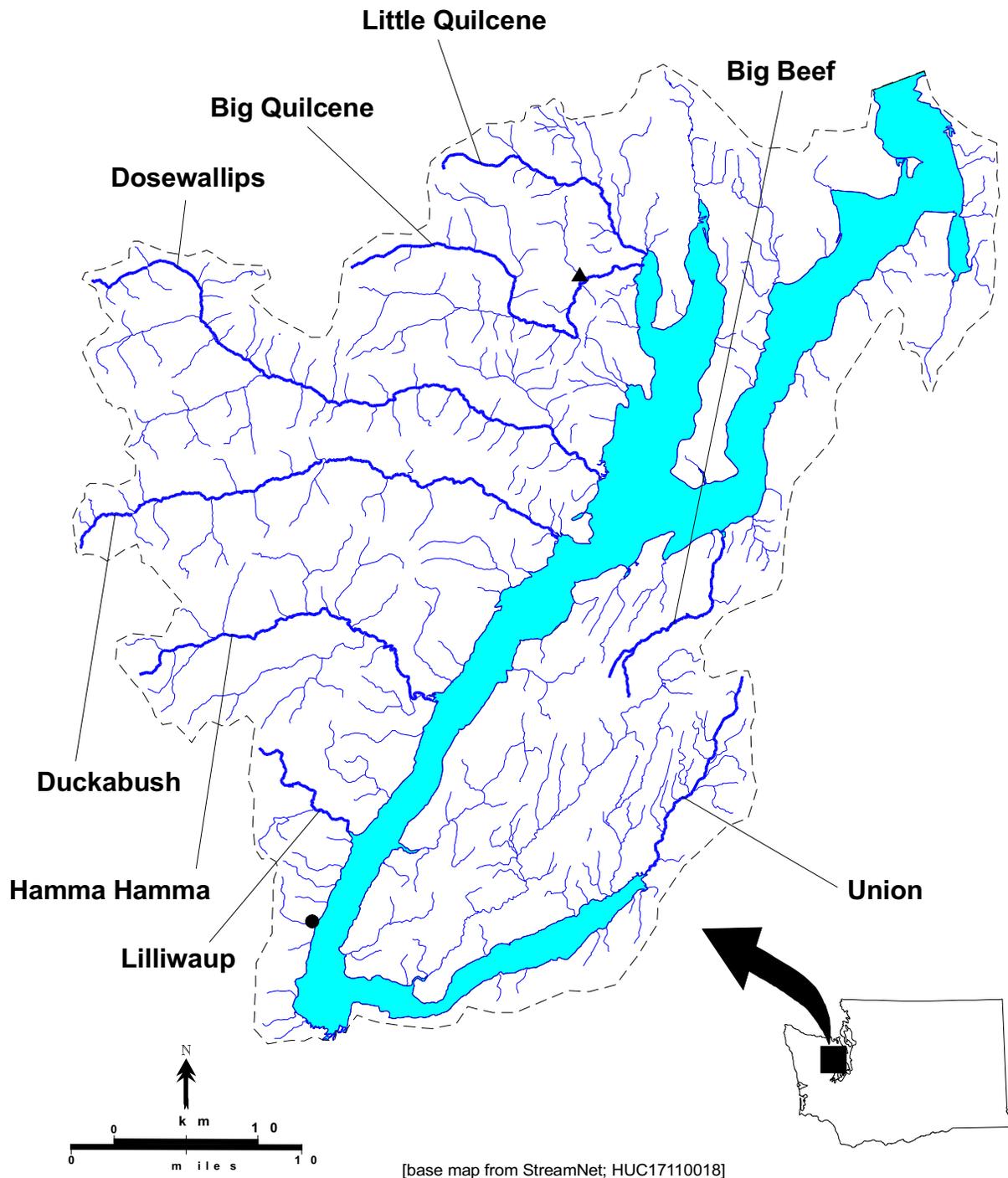




Figure 3. Interrelationship of 35 summer and fall chum salmon populations from the Strait of Juan de Fuca, Hood Canal, Puget Sound, the Fraser River, and the Strait of Georgia based on two-dimensional multidimensional scaling of Cavalli-Sforza and Edwards (1967) chord distances using NTSYS-pc. Stress2 = 0.22454 = Fair

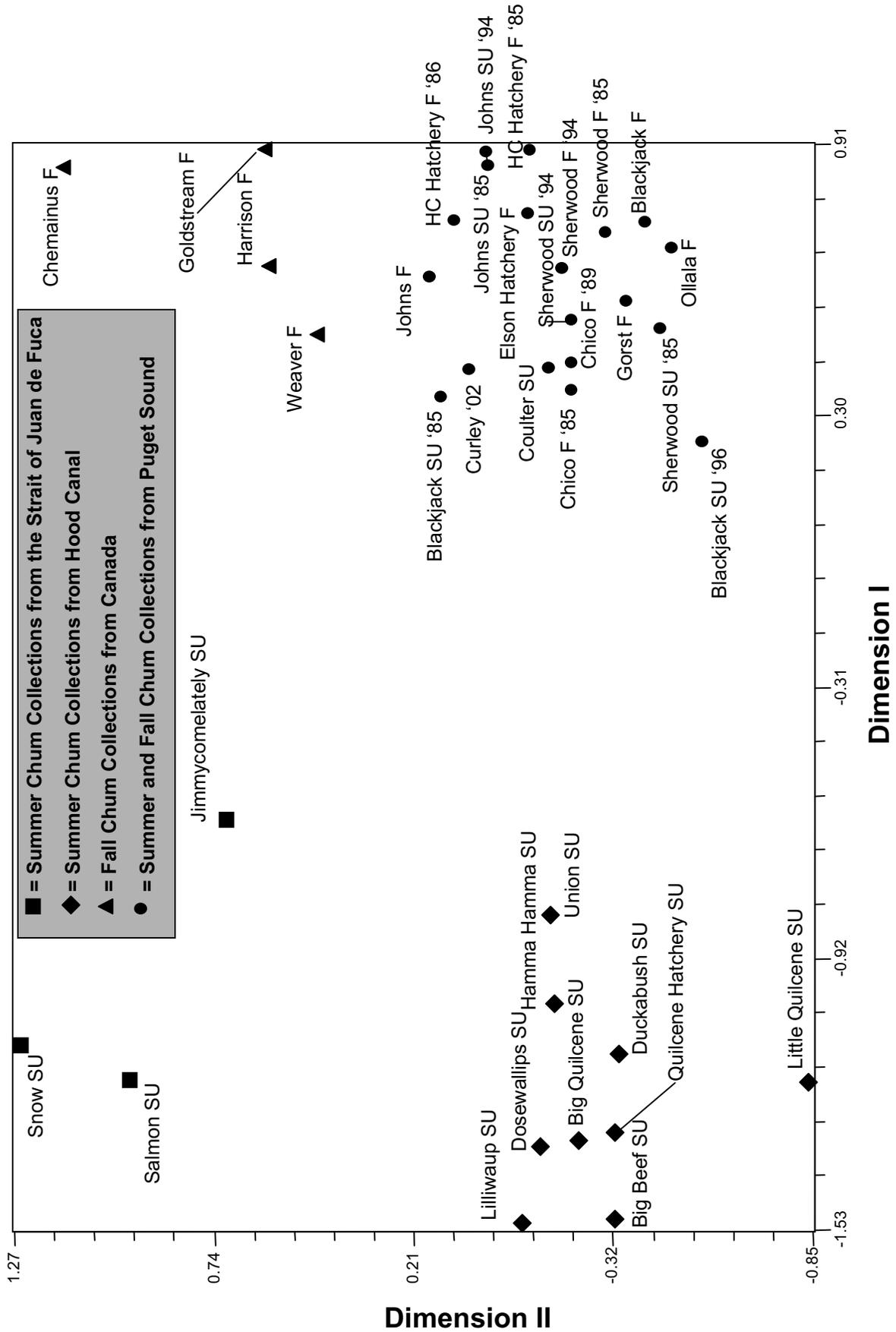


Figure 4. Interrelationship of 35 summer and fall chum salmon populations from the Strait of Juan de Fuca, Hood Canal, Puget Sound, the Fraser River, and the Strait of Georgia based on three dimensional multidimensional scaling of Cavalli-Sforza and Edwards (1967) chord distances using NTSYS-pc. Stress2 = 0.18224 = Good

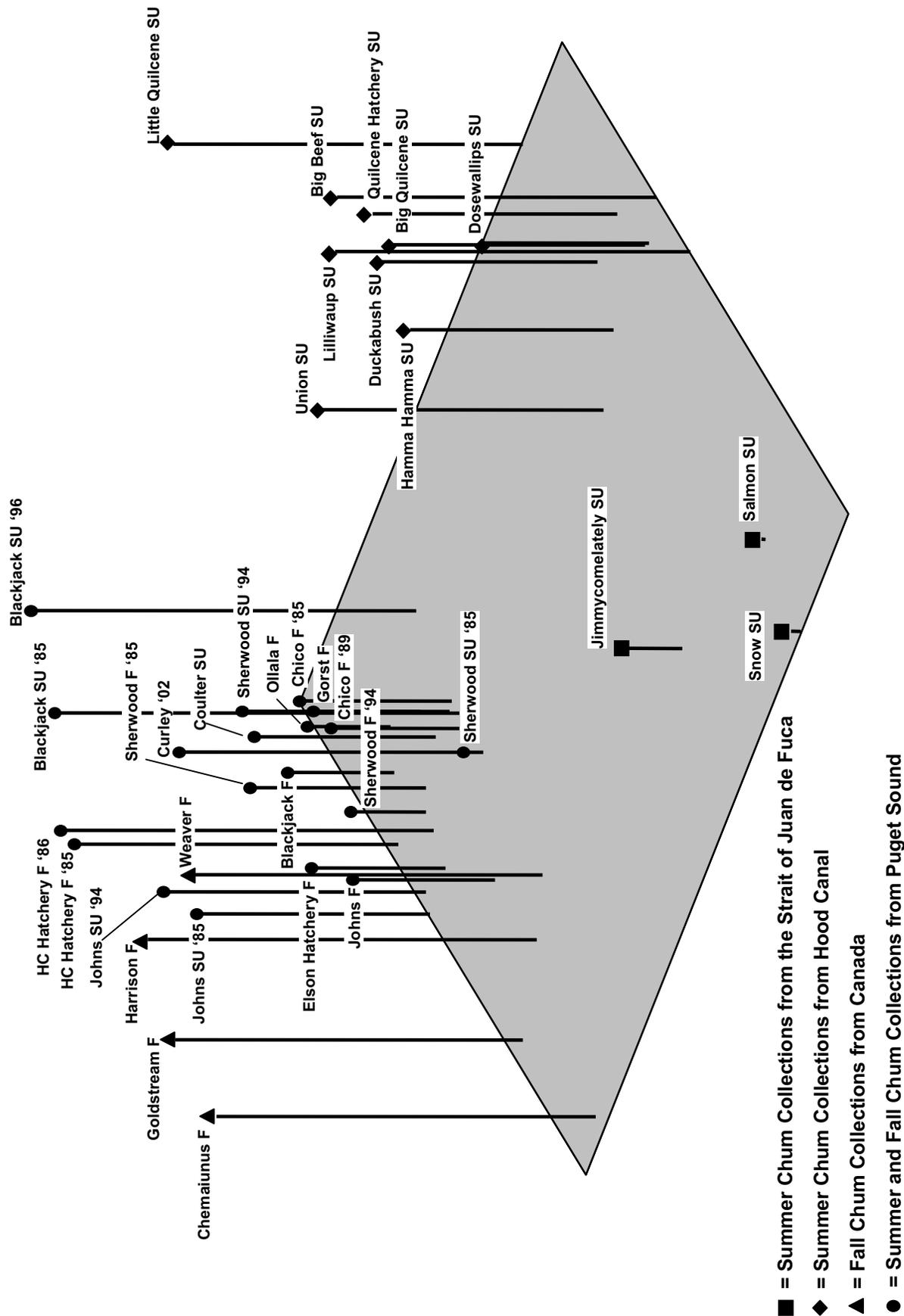


Table 1. Collection details for summer and fall chum from Hood Canal, Puget Sound, Strait of Georgia, and Fraser River. <sup>1</sup> = genetic file used in analyses, if different from collection code. # = number for the aggregate collections or population shown in Figure 2.

#	Collection Location	Collection Year	Collection N =	Collection Code	Database Used <sup>1</sup>	Collection Date
<b>Hood Canal - Summer</b>						
1	Union River	1986	100	86QH	86H	9/16/86
	Union River	1993	27	93GM		9/16 - 10/4/93
	Union River	1995	76	95GJ		9/8 - 10/3/95
	Union River	2000	81	00EF		9/5 - 10/2/00
	Union River	2001	85	01GX		9/4 - 9/25/01
	Total		<b>369</b>			
2	Lilliwaup Creek	1985	32	85YA	51A1	10/3 - 10/16/85
	Lilliwaup Creek	1986	28	86QQ	86Q4	9/28 - 10/8/86
	Lilliwaup Creek	1992	60	92GE		9/17 - 10/7/92
	Lilliwaup Creek	1993	4	93GE		9/13 - 10/13/93
	Lilliwaup Creek	1997	24	97DU		9/16 - 10/1/97
	Lilliwaup Creek	1998	21	98EV		9/20 - 10/12/98
	Lilliwaup Creek	1999	6	99EE		9/16 - 10/11/99
	Lilliwaup Creek	2000	13	00EJ		9/7 - 10/9/00
	Total		<b>188</b>			
3	Hamma Hamma R.	1985	7	85YA	51A2	10/3 - 10/16/85
	Hamma Hamma R.	1986	29	86QQ	86Q3	9/28 - 10/8/86
	Hamma Hamma R.	1994	28	94HB		9/4 - 10/2/94
	Hamma Hamma R.	1995	19	95GI		9/19 - 10/4/95
	Hamma Hamma R.	1997	18	97DV		9/16 - 9/25/97
	Hamma Hamma R.	1998	28	98EX		9/6 - 9/29/98
	Hamma Hamma R.	1999	45	99EL		9/7 - 9/23/99
	Hamma Hamma R.	2000	56	00EI		9/7 - 10/19/00
	Total		<b>230</b>			
4	Duckabush River	1985	9	85YA	51A3	10/3 - 10/16/85
	Duckabush River	1986	39	86QQ	86Q1	9/28 - 10/8/86
	Duckabush River	1992	77	92HC		10/1 - 10/22/92
	Duckabush River	1998	6	98FW		9/29 - 10/6/98
	Total		<b>131</b>			
5	Dosewallips River	1986	2	86QQ	86Q2	9/28 - 10/8/86
	Dosewallips River	1992	100	92GF		9/15 - 9/30/92
	Dosewallips River	1998	50	98FX		9/23 - 10/6/98
	Total		<b>152</b>			
6	Big Beef Creek	2000	20	00FM		9/18 - 10/3/00
	Big Beef Creek	2001	63	01HB		9/10 - 10/4/01
	Total		<b>83</b>			
7	Big Quilcene River	1992	102	92GB		9/1 - 9/14/92
	Quilcene Bay	1992	138	92GD		9/14 - 9/28/92
	Quilcene Bay	1993	26	93GD		9/28 - 10/1/93
	Quilcene Bay	1994	100	94HF		9/16 - 9/26/94
	Total		<b>366</b>			

Table 1 continued.

#	Collection Location	Collection Year	Collection N =	Collection Code	Database Used <sup>1</sup>	Collection Date
<b>Hood Canal - Summer</b>						
8	Quilcene NFH	1997	58	97DM		9/12 - 10/9/97
	Quilcene NFH	1997	96	97DS		9/12 - 9/22/97
	Total		154			
9	Little Quilcene River	1999	30	99EU		9/16 - 10/6/99
10	Snow Creek	1986	50	86QU	86U2	10/2 - 10/9/86
11	Salmon Creek	1986	50	86QU	86U1	10/2 - 10/9/86
	Salmon Creek	1997	100	97DO		9/15 - 10/2/97
	Total		150			
12	Jimmycomelately Cr.	1986	100	86QM	86M	9/26 - 10/2/86
	Jimmycomelately Cr.	2000	35	00GF		9/12 - 10/5/00
	Jimmycomelately Cr.	2001	74	01GJ		9/6 - 10/3/01
	Total		209			
<b>Hood Canal - Fall</b>						
13	Hood Canal Hatchery	1985	100	85YQ	17A	11/8/85
14	Hood Canal Hatchery	1986	100	86QX	86X	11/14/85
<b>Puget Sound - Summer</b>						
15	BlackJack Creek	1985	100	85YC	13A	10/15 - 10/29/85
16	BlackJack Creek	1996	100	96CO		10/2 - 10/22/96
17	Johns Creek	1985	100	85YE	12A	10/8/85
18	Johns Creek	1994	100	94GP		10/5 - 10/18/94
19	Sherwood Creek	1985	100	85YF	44A	10/7 - 10/11/85
20	Sherwood Creek	1994	98	94GR		10/13 - 10/27/94
21	Coulter Creek	1985	100	85TD	15A	10/7 - 10/10/85
<b>Puget Sound - Fall</b>						
22	Ollala Creek	1993	100	93GL		12/30/93
23	Blackjack Creek	1998	100	98LO		1/4 - 1/12/98
24	Chico Creek	1985	100	85YL	11A	11/16/85
25	Chico Creek	1989	96	89BR		11/14 - 11/28/89
26	Gorst Creek	1985	100	85YH	21A	12/30/85
27	Johns @ Elson FH	1985	100	85YI	26A	12/27/85
28	Elson FH	1985	100	85YN	27A	12/10/85
29	Sherwood Creek	1985	106	85ZD	34A	11/17 - 11/18/85
30	Sherwood Creek	1994	100	94GS		11/14 - 12/12/94

Table 1 continued.

#	Collection Location	Collection Year	N =	Collection Code	Database Used <sup>1</sup>	Collection Date
<b>Colvos Passage - Puget Sound</b>						
31	Curley Creek	2002	100	02KS		10/31 - 11/14/02
<b>Outgroups</b>						
<u>lower Strait of Georgia</u>						
32	Chemainus River	1988	100	88AM		
33	Goldstream River	1987	100	87CA		
<u>mid Fraser River</u>						
34	Weaver Creek	1988	100	88AT		
35	Harrison River	1992	100	92HG		

Table 2. Pairwise comparisons of summer chum collected over multiple years from each of 12 locations in Hood Canal. P-values shown for each pairwise comparison were calculated using GENEPOP. N = number of fish in each collection/aggregate collection. Pairwise comparisons that were significantly different after Bonferonni correction for multiple tests (Rice 1989) are highlighted in black with white type.

N	Collection	1986	1993	1995	2000	2001
100	Union '86	/				
27	Union '93	0.47126	/			
76	Union '95	0.93222	0.65545	/		
81	Union '00	0.04743	0.81681	0.04671	/	
85	Union '01	0.03064	0.17722	0.00931	0.8282	/

N	Collection	1985	1986	1992	1993	1997	1998	1999	2000
32	Lilliwaup '85	/							
28	Lilliwaup '86	0.99997	/						
60	Lilliwaup '92	0.69601	0.5619	/					
4	Lilliwaup '93	0.85738	0.90067	0.55631	/				
24	Lilliwaup '97	0.11841	0.08894	0.67297	0.61797	/			
21	Lilliwaup '98	0.39170	0.34979	0.09288	0.37039	0.01296	/		
6	Lilliwaup '99	0.99049	0.96906	0.99267	0.83146	0.91348	0.97590	/	
13	Lilliwaup '00	0.98791	0.91816	0.99828	0.98675	0.99325	0.19623	0.99053	/

N	Collection	1985	1986	1994	1995	1997	1998	1999	2000
7	Hamma Hamma '85	/							
29	Hamma Hamma '86	0.99988	/						
28	Hamma Hamma '94	0.98251	0.89055	/					
19	Hamma Hamma '95	0.99536	0.72661	0.36086	/				
18	Hamma Hamma '97	0.95116	0.99878	0.95405	0.95545	/			
28	Hamma Hamma '98	0.92592	0.98418	0.92893	0.36127	0.99837	/		
45	Hamma Hamma '99	0.96974	0.83412	0.44071	0.49720	0.67520	0.38035	/	
56	Hamma Hamma '00	0.99838	0.94271	0.55788	0.44403	0.96499	0.74406	0.40265	/

N	Collection	1985	1986	1992	1998
9	Duckabush '85	/			
39	Duckabush '86	0.86516	/		
77	Duckabush '92	0.29621	0.67037	/	
6	Duckabush '98	0.57687	0.99192	0.97499	/

Table 2 continued.

N	Collection	1986	1992	1998
2	Dosewallips '86	/		
100	Dosewallips '92	0.15250	/	
50	Dosewallips '98	0.25416	<b>0.00301</b>	/
N	Collection	2000	2001	
20	Big Beef '00	/		
63	Big Beef '01	0.62068	/	
N	Collection	1992	1992	1993
102	Big Quilcene R '92	/		
138	Big Quilcene Bay '92	0.60804	/	
26	Big Quilcene R/Bay '93	0.59301	0.66212	/
100	Big Quilcene R/Bay '94	0.02391	0.04678	0.05088 /
N	Collection	1997	1997	
58	Quilcene NFH '97	/		
96	Quilcene NFH '97	0.67732	/	
N	Collection	1986	1997	
50	Salmon '86	/		
100	Salmon '97	0.24305	/	
N	Collection	1986	2000	2001
100	Jimmycomelately '86	/		
35	Jimmycomelately '00	0.09909	/	
74	Jimmycomelately '01	0.02305	0.21283	/

Table 3. Pairwise comparisons of 25 summer chum collections in Hood Canal. P-values shown for each pairwise comparison were calculated using GENEPOP. N = number of fish in each collection/aggregate collection. Values of 0.0 = test values that reached infinity, therefore P-values were undefined but less than 0.00000. Pairwise comparisons that were significantly different (0.00000) are highlighted in black with white type. Pairwise comparisons that are defined as significant after Bonferroni correction for multiple tests (Rice 1989; 300 comparisons; alpha = 0.05/300 = 0.00017) are highlighted in grey. Additionally, pairwise comparisons whose P-values were no greater than twice the corrected alpha level were also highlighted in grey. This was done to identify pairwise comparisons that were close to the corrected alpha value for the computer run that is tabulated, but may change from significant to non-significant, if additional analyses were conducted (due to the Monte Carlo resampling implemented by GENEPOP).

N	Union '86	Union '95	Union '00	Union '01	Lilliwaup '85, '86	Lilliwaup '92	Lilliwaup '93, '95, '97, '98, '94, '95, '97	Hamma '85, '86, '94, '95, '97	Hamma '98, '99	Hamma '00	Duck '85, '86	Duck '92
100 Union '86	/											
103 Union '93, '95	0.94504	/										
81 Union '00	0.04545	0.10840	/									
85 Union '01	0.03244	0.01128	0.82706	/								
60 Lilliwaup '85, '86	0.00251	0.01153	0.00862	0.00210	/							
60 Lilliwaup '92	<b>0.00000</b>	<b>0.0</b>	<b>0.00008</b>	<b>0.00009</b>	0.38717	/						
68 Lilliwaup '93, '95, '97, '00	<b>0.00014</b>	0.00124	<b>0.00015</b>	<b>0.00007</b>	0.16046	0.70625	/					
101 Hamma '85, '86, '94, '95, '97	0.07510	0.00151	0.00274	<b>0.00005</b>	0.56605	0.00056	0.00119	/				
73 Hamma '98, '99	0.04070	0.00134	0.00242	0.00556	0.56041	0.06499	0.02497	0.80852	/			
56 Hamma '00	0.28096	0.04316	0.01346	0.00562	0.58856	<b>0.00004</b>	0.00017	0.48232	0.66914	/		
48 Duckabush '85, '86	0.42741	0.39196	0.21991	0.01036	0.24458	0.00324	0.07729	0.81061	0.22660	0.28714	/	
77 Duckabush '92	0.00919	0.00091	<b>0.00000</b>	<b>0.0</b>	0.04668	<b>0.0</b>	<b>0.00001</b>	0.39899	0.35020	0.24270	0.28001	/
100 Dosewallips '92	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	0.00670	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
50 Dosewallips '98	0.00300	0.00051	<b>0.00001</b>	<b>0.00042</b>	0.36461	0.00773	0.00171	0.11127	0.54753	0.18247	0.02730	0.02198
83 Big Beef '00, '01	0.00091	0.00036	0.00221	0.00053	0.47875	0.13638	0.01688	0.28643	0.71200	0.06970	0.08485	0.32396
102 Big Quilcene R '92	0.00098	<b>0.00001</b>	<b>0.00001</b>	<b>0.00007</b>	0.53366	0.00306	<b>0.00004</b>	0.62734	0.42565	0.13534	0.00687	0.01680
138 Big Quilcene Bay '92	<b>0.0</b>	<b>0.0</b>	<b>0.00000</b>	<b>0.00000</b>	0.16032	0.00053	<b>0.00000</b>	0.04594	0.72335	0.07357	0.00093	0.12803
126 Big Quilcene R/Bay '93, '94	0.00098	<b>0.00001</b>	<b>0.0</b>	<b>0.00000</b>	0.45571	0.00053	<b>0.00002</b>	0.54103	0.64440	0.67247	0.11262	0.20115
58 Quilcene NFH '97	<b>0.00010</b>	<b>0.00002</b>	<b>0.00000</b>	<b>0.00000</b>	0.19655	0.00012	0.00044	0.02018	0.06677	0.10077	0.07130	0.17672
96 Quilcene NFH '97	0.00090	<b>0.0</b>	<b>0.00000</b>	<b>0.00000</b>	0.23106	<b>0.00017</b>	<b>0.00002</b>	0.12684	0.54843	0.71541	0.14204	0.80769
50 Snow Creek '86	<b>0.0</b>	<b>0.00001</b>	<b>0.00001</b>	<b>0.00000</b>	0.00044	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.00011</b>	<b>0.00011</b>	<b>0.0</b>
50 Salmon '86	<b>0.00000</b>	<b>0.00000</b>	<b>0.00000</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.00000</b>	<b>0.00001</b>	<b>0.00004</b>	<b>0.00001</b>	<b>0.0</b>
100 Salmon '97	<b>0.00000</b>	<b>0.0</b>	<b>0.00000</b>	<b>0.00000</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.00002</b>	<b>0.00000</b>	<b>0.0</b>
100 Jimmycomelately '86	<b>0.00000</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.00004</b>	<b>0.00000</b>	<b>0.00000</b>	<b>0.00000</b>	<b>0.00001</b>	<b>0.00017</b>	<b>0.00137</b>	<b>0.00000</b>
109 Jimmycomelately '00, '01	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.00000</b>	<b>0.0</b>	<b>0.0</b>	<b>0.00000</b>	<b>0.00000</b>	<b>0.0</b>	<b>0.00000</b>	<b>0.0</b>

Table 3 continued.

N	Dose '92	Dose '98	Beef '00, '01	BQuil '92	BQuil '92	BQuil '93, '94	Quil NFH '97	Quil NFH '97	Snow '86	Salmon '86	Salmon '97	JCL '86
100 Union '86	/	/	/									
103 Union '93, '95	0.00241	0.16706										
81 Union '00	0.0	0.05934	0.38512	/								
85 Union '01	0.0	0.19524	0.29365	0.59932	/							
60 Lilliwaup '85, '86	0.0	0.34443	0.03048	0.13526	0.34047	/						
60 Lilliwaup '92	0.0	0.03624	0.00091	<b>0.00013</b>	0.00203	0.48131	/					
68 Lilliwaup '93, '95, '97, '00	0.0	0.16464	0.07819	0.01468	0.39192	0.97629	0.67299	/				
101 Hamma '85, '86, '94, '95, '97	0.0	0.0	0.0	0.0	0.0	0.0	<b>0.00002</b>	0.0	/			
73 Hamma '98, '99	0.0	0.00000	0.0	0.0	0.0	0.0	<b>0.00000</b>	0.0	0.24180	/		
56 Hamma '00	0.0	0.0	0.0	0.0	0.0	0.0	<b>0.00000</b>	0.0	0.19446	0.24245	/	
48 Duckabush '85, '86	0.0	<b>0.00008</b>	0.0	<b>0.00000</b>	0.0	0.0	<b>0.00006</b>	0.0	0.01735	<b>0.00005</b>	<b>0.00029</b>	/
77 Duckabush '92	0.0	0.00000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<b>0.00000</b>	<b>0.0</b>	0.00539
100 Dosewallips '92												
50 Dosewallips '98												
83 Big Beef '00, '01												
102 Big Quilcene R '92												
138 Big Quilcene Bay '92												
126 Big Quilcene R/Bay '93, '94												
58 Quilcene NFH '97												
96 Quilcene NFH '97												
50 Snow Creek '86												
50 Salmon '86												
100 Salmon '97												
100 Jimmycomelately '86												
109 Jimmycomelately '00, '01												

Table 4. Pairwise comparisons of summer chum collected from 12 locations in Hood Canal. N = number of fish in each collection/aggregate collection. Values of 0.0 = test values that reached infinity, therefore P-values were undefined but less than 0.00000. Pairwise comparisons that were significantly different (0.00000) are highlighted in black with white type. Pairwise comparisons that are defined as significant after Bonferroni correction for multiple tests (Rice 1989; 66 comparisons; alpha = 0.05/66 = 0.00075) are highlighted in grey. Additionally, pairwise comparisons whose P-values were no greater than twice the corrected alpha level were also highlighted in grey. This was done to identify pairwise comparisons that were close to the corrected alpha value for the computer run that is tabulated, but may change from significant to non-significant, if additional analyses were conducted (due to the Monte Carlo resampling implemented by GENEPOP).

N	Union All	Lilliwaup All	Hamma All	Duck All	Dose All	Beef Both	BQuil All	Quil NFH Both	LQuil '99	Snow '86	Salmon Both	JCL All
369 Union '86, '93, '95, '00, '01	/											
104 Lilliwaup '85, '86, '92, '93, '95, '97, '00	0.0	/										
230 Hamma '85, '86, '94, '95, '97, '98, '99, '00	0.0	0.0	/									
131 Duckabush '85, '86, '92, '98	0.0	0.0	0.15065	/								
52 Dosewallips '86, '92, '98	0.0	0.0	0.0	0.0	/							
83 Big Beef '00, '01	0.0	0.00050	0.17098	0.11766	0.01781	/						
366 Big Quilcene R/Bay '92, '93, '94	0.0	0.0	0.05337	0.00016	0.0	0.07568	/					
154 Quilcene NFH '97, '97	0.0	0.0	0.00270	0.04247	0.0	0.00087	0.00260	/				
30 L Quilcene R. '99	0.00067	0.00566	0.13712	0.46993	0.01466	0.07272	0.05812	0.37017	/			
50 Snow Creek '86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	/		
150 Salmon '86, '97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.25356	/	
209 Jimmycomelately (JCL) '86, '00, '01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	/

Table 5. Pairwise comparisons for Curley Creek and seven other collection sites of summer chum from Puget Sound. N = number of fish in each collection/aggregate collection. Values of 0.0 = test values that reached infinity, therefore P-values were undefined but less than 0.00000. Pairwise comparisons that were significantly different (0.00000) are highlighted in black with white type. Pairwise comparisons that are defined as significant after Bonferroni correction for multiple tests (Rice 1989; 28 comparisons;  $\alpha = 0.05/28 = 0.00179$ ) are highlighted in grey. Additionally, pairwise comparisons whose P-values were no greater than twice the corrected alpha level were also highlighted in grey. This was done to identify pairwise comparisons that were close to the corrected alpha value for the computer run that is tabulated, but may change from significant to non-significant, if additional analyses were conducted (due to the Monte Carlo resampling implemented by GENEPOP).

N	Curley '02	Blackjack '85	Blackjack '96	Johns '85	Johns '94	Sherwood '85	Sherwood '94	Coulter '85
100	/							
100	0.38457	/						
100	0.08779	0.61655	/					
100	0.00000	0.00000	0.0	/				
100	0.00000	0.00000	0.00000	0.96496	/			
100	0.00000	0.0	0.00000	0.0	<b>0.00001</b>	/		
98	<b>0.00015</b>	0.00000	0.00000	<b>0.00178</b>	0.02326	0.02358	/	
100	<b>0.00045</b>	<b>0.00004</b>	0.00000	0.00617	0.04395	0.00736	0.19789	/

## Appendix 1. Nine-gel screening protocol for analyzing chum baseline samples.

### **Muscle**

Tris-Gly      35mm origin, 5 1/2 hours @ 600v/90ma, 3/8", Starch Art

MEP+PGM (mMEP-2, PGM-2) **add 20mg oxalacetic acid**  
PEPA+PEPB (PEPA, PEPB1T) **use pH 8.0 buffer**  
AAT (sAAT-1,2) **use pH 7.0 buffer**  
ESTD (ESTD-1) uv stain (scrape and stain for LDH)  
LDH (LDH-A1, LDH-A2, LDH-B1, LDH-B2) **Do Not label plate**  
ALAT  
GPI (GPI-A, GPI-B1,2)  
CK (CK-A1, CK-A2) Use top slice if necessary

CAME 6.8      35mm origin, 5 1/4 hours @ 250V75ma, 1/4", Connaught

AH (mAH-3<sup>1</sup>, mAH-4) **Use Heart Gel to Enter Scores**  
FH  
ALAT  
AAT (mAAT-1) **c only, use pH 7.7 buffer**  
IDHP (mIDHP-1)  
MEP (mMEP-2, sMEP-1) **add 20mg oxalacetic acid**  
LDH (LDH-A1) **c only**

### **Heart**

CAME 7.0      35mm origin, 5 1/4 hours @ 250V75ma, 3/8", Connaught  
Use CAME 6.8 header for merging headers and Fish ID's

MDH (mMDH-2, mMDH-3) **a+c**  
GAPDH (GAPDH-2, GAPDH-3)  
IDHP+PGDH (mIDHP-1, PGDH)  
AH (mAH-1, mAH-2, mAH-3<sup>1</sup>, mAH-4)  
G3PDH (G3PDH-1, G3PDH-2, G3PDH-3)  
AAT (mAAT-1) **c only, use pH 7.7 buffer**

CAM 5.9      35mm origin, 6 hours @ 250V75ma, 1/4", Connaught  
Use CAME 6.1 header for merging headers and Fish ID's

MDH (mMDH-1, sMDH-A1, sMDH-A2, sMDH-B1,2) **a+c**  
MEP (sMEP-1) **add 20mg oxalacetic acid**  
SOD (sSOD-1, mSOD) **a+c**  
PEPB (PEPB-1C) **c only, use pH 8.5 buffer**  
G3PDH (G3PDH-1, G3PDH-2) **a+c**

EBT              35mm origin, run dye to end of gel, 400V/80ma, 1/4", Connaught

GAPDH (GAPDH-2, GAPDH-3)  
AAT (sAAT-1,2) **use pH 7.0 buffer**  
MPI  
SOD (sSOD-1, mSOD)  
ESTD (ESTD-1, ESTD-2) **uv stain**

Appendix 1 continued.

**Liver**

CAM 6.8      35mm origin, 5 1/4 hours @ 250V75ma, 1/4", Connaught

IDHP+PGDH (sIDHP-1, sIDHP-2, PGDH)  
BGLUA (bGLUA-2<sup>2</sup>)  
MPI  
AAT (mAAT-2) c only, use 200mg D-3502 fast blue per overlay

CAM 5.9      35mm origin, 6 hours @ 250V80ma, 1/4", Connaught  
Use CAME 6.1 header for merging headers and Fish ID's

MDH (sMDH-A1, sMDH-A2) **a+c**  
bGLUA (bGLUA-2<sup>2</sup>)  
PEPB (PEPB-1C) **c only**

**Eye**

CAM 6.8      35mm origin, 5 1/4 hours @ 250V75ma, 1/4", Connaught

LDH (LDH-C)  
IDHP (sIDHP-1, sIDHP-2)  
MPI  
MEP (sMEP-1) **add 20mg oxalacetic acid**

Tris-Gly      35mm origin, 5 1/4 hours @ 550V80ma, 1/4", Starch Art

AAT (sAAT-3) use pH 7.0 buffer  
TPI (TPI-1, TPI-2, TPI-3, TPI-4) keep cathode  
LDH (LDH-B1, LDH-B2, LDH-C)

<sup>1</sup> = Dropped from CAME 6.8 muscle header. Use the CAME 7.0 heart and the CAME 6.0 muscle gels in combination to obtain one set of scores for this locus and enter them on the CAME 7.0 heart header.

<sup>2</sup> = Dropped from the CAM 6.1 header. Use the CAM 6.8 liver and the CAM 6.1 liver gels in combination to obtain one set of scores for this locus and enter them on the CAM 6.8 liver header.

Except where otherwise noted use the following staining buffers:

EBT, Tris-Gly – pH 7.0

CAME 6.8, CAM 6.8, CAME 7.0 – pH 8.0

CAM 5.9 – pH 8.5

Appendix 2. Loci and recognized alleles (identified by relative electrophoretic mobilities) for summer and fall chum salmon in Hood Canal and Puget Sound.

Loci	Buffer	Tissue Analyzed													
			A	B	C	D	E	F	G	H	I	J			
<b>mAAT-1</b>	CAME 6.8	M	-100	-120	-70	-110									
	CAME 7.0	H	-100	-120	-70	-110									
<b>sAAT-1,2</b>	TG	M	100	120	65	113		95	84						
	EBT	H	100	120	65	113		95	84						
<b>sAAT-3</b>	<b>A</b> TG	E	100	90	110	70		74							
<b>mAH-1</b>	CAME 7.0	H	100	50	200	81									
<b>mAH-3</b>	CAME 6.8	M	100	124	115	140									
	CAME 7.0	H	100	124	115	140									
<b>mAH-4</b>	CAME 6.8	M	100	120	105										
	CAME 7.0	H	100	120	105										
<b>ALAT</b>	TG	M	100	93	105			98	78						
	CAME 6.8	M	100	93	105			98	78						
<b>CK-A1</b>	TG	M	100	70	114										
<b>CK-A2</b>	TG	M	100	110	80										
<b>ESTD-1</b>	TG	M	100	91	110										
	EBT	H	100	91	110										
<b>ESTD-2</b>	<b>B</b> EBT	H	100	87											
<b>FH</b>	CAME 6.8	M	100	75	125										
<b>GAPDH-2</b>	CAME 7.0	H	100	50	160	175									
	EBT	H	100	50	160	175									
<b>GAPDH-3</b>	CAME 7.0	H	100	117											
	EBT	H	100	117											
<b>bGLUA</b>	CAM 6.8	L	100	15											
	CAM 5.9	L	100	15											
<b>GPI-A</b>	TG	M	100	95	105										
<b>GPI-B1,2</b>	TG	M	100	145	40										
<b>G3PDH-1</b>	CAME 7.0	H	-100	-76	-110										
	CAM 5.9	H	-100	-76	-110										
<b>G3PDH-2</b>	CAME 7.0	H	100	90	131										
	CAM 5.9	H	100	90	131										
<b>G3PDH-3</b>	CAME 7.0	H	100	115	80										
<b>mIDHP-1</b>	CAME 6.8	M	100	60	140	20	85								
	CAME 7.0	H	100	60	140	20	85								
<b>sIDHP-1</b>	<b>C</b> CAM 6.8	L, E	100	70	130	112									
<b>sIDHP-2</b>	CAM 6.8	L, E	100	35	85	25	20	110	28	45	65	58			
<b>LDH-A1</b>	TG	M	-100	-50	-66										
	CAME 6.8	M	100												
<b>LDH-A2</b>	TG	M	100	65											
<b>LDH-B1</b>	TG	M, E	100	75	160										
<b>LDH-B2</b>	TG	M, E	100	120	60	115									
<b>LDH-C</b>	CAM 6.8	E	100	95	103										
	TG	E	100	95	103										
<b>mMDH-1</b>	CAM 5.9	H	-100	-50	-120										
<b>mMDH-2</b>	CAME 7.0	H	100	158											
<b>mMDH-3</b>	CAME 7.0	H	100	200	50										

Appendix 2 continued.

Loci	Buffer	Tissue Analyzed		B	C	D	E	F	G	H	I	J
<i>sMDH-A1</i>	CAM 5.9	H, L	100	200	400	10						
<b><i>sMDH-A2</i></b>	CAM 5.9	H, L	100	15			50					
<u><i>sMDH-B1.2</i></u>	CAM 5.9	H	100	72	50	130	145	20	124	85		
<b><i>mMEP-2</i></b>	TG	M	100	110	75							
	CAME 6.8	M	100	122	75							
<i>sMEP-1</i>	CAME 6.8	M	100	90	110	80						
	CAM 5.9	H	100	90	110	80						
	CAM 6.8	E	100	90	110	80						
<b><i>MPI</i></b>	EBT	H	100	92	112		84					
	CAM 6.8	L, E	100	92	112		84					
<i>PEPA</i>	TG	M	100	110	90							
<b><i>PEPB-1T</i></b>	TG	M	100	59	110	200						
<b><i>PEPB-1C</i></b>	CAM 5.9	H,L	-100	-146	-126	-127	-72	-50				
<i>PGDH</i>	CAME 7.0	H	100	88	104	93	110					
	CAM 6.8	L	100	88	104	93	110					
<i>PGM-2</i>	TG	M	100	128	75							
<i>mSOD</i>	CAM 5.9	H	100									
	EBT	H	100									
<i>sSOD-1</i>	CAM 5.9	H	100	40	200							
	EBT	H	100	40	200							
<i>TPI-1</i>	TG	E	-100	-50	-175							
<i>TPI-2</i>	TG	E	-100	-85								
<i>TPI-3</i>	TG	E	100	95	80	105	67					
<i>TPI-4</i>	TG	E	100	96	104							

**Bold type** = Loci polymorphic at  $P_{0.95}$  level. Underlined = Loci polymorphic at  $P_{0.99}$  level.

A = Locus was not used for the pairwise tests of the individual Hood Canal collections.

B = Locus was only used for the pairwise tests of the combined Hood Canal collections.

C = Locus was only used for the pairwise tests of Hood Canal collections.

Appendix 3. Allele frequencies of summer and fall chum from the Strait of Juan de Fuca, Hood Canal, Puget Sound, the Fraser River, and the Strait of Georgia. Note that the frequencies for Hood Canal and the Strait of Juan de Fuca are aggregate of multiple collections.

	<u>St of Juan de Fuca SU</u>			<u>Hood Canal SU</u>						
	Salmon SU	Snow SU	JCL SU	Union SU	Lilliwaup SU	Hamma Hamma SU	Duckabush SU	Dosewallips SU	Big Beef SU	Big Quilcene R/Bay SU
<i>mAAT-1</i>										
(N)	150	50	209	318	186	230	130	151	83	364
100	0.543	0.570	0.713	0.486	0.508	0.524	0.538	0.523	0.446	0.532
120	0.457	0.430	0.280	0.514	0.492	0.476	0.458	0.474	0.554	0.468
70	/	/	0.007	/	/	/	0.004	0.003	/	/
<i>sAAT-1,2</i>										
(N)	150	50	209	369	188	229	131	152	83	366
100	0.865	0.895	0.856	0.949	0.936	0.941	0.954	0.952	0.943	0.953
120	0.135	0.105	0.144	0.051	0.064	0.059	0.046	0.048	0.057	0.047
65	/	/	/	/	/	/	/	/	/	/
<i>sAAT-3</i>										
(N)	150	50	107	268	153	221	120	149	82	360
100	0.350	0.370	0.308	0.504	0.529	0.679	0.642	0.654	0.713	0.708
90	0.650	0.630	0.692	0.438	0.395	0.310	0.350	0.339	0.274	0.264
110	/	/	/	/	0.007	/	/	/	/	/
70	/	/	/	0.058	0.069	0.011	0.008	0.007	0.012	0.028
<i>mAH-3</i>										
(N)	144	50	195	364	187	220	131	152	82	363
100	0.563	0.700	0.654	0.505	0.586	0.527	0.542	0.638	0.561	0.500
124	0.438	0.300	0.346	0.495	0.414	0.473	0.458	0.362	0.439	0.500
115	/	/	/	/	/	/	/	/	/	/
<i>ALAT</i>										
(N)	149	50	209	368	188	229	131	151	83	365
100	0.879	0.880	0.897	0.912	0.843	0.906	0.885	0.897	0.892	0.918
93	0.121	0.120	0.103	0.080	0.154	0.092	0.115	0.103	0.108	0.079
105	/	/	/	0.008	0.003	0.002	/	/	/	0.003
98	/	/	/	/	/	/	/	/	/	/
78	/	/	/	/	/	/	/	/	/	/
<i>ESTD-2</i>										
(N)	98	0	107	262	126	188	83	149	81	363
100	0.929		0.958	0.954	0.944	0.931	0.946	0.936	0.926	0.944
87	0.071		0.042	0.046	0.056	0.069	0.054	0.064	0.074	0.056
<i>G3PDH-2</i>										
(N)	149	50	208	366	182	183	131	143	81	356
100	0.983	0.930	0.918	0.873	0.852	0.923	0.847	0.906	0.883	0.916
90	0.017	0.070	0.082	0.127	0.148	0.077	0.153	0.094	0.105	0.084
131	/	/	/	/	/	/	/	/	0.012	/

	<u>St of Juan de Fuca SU</u>			<u>Hood Canal SU</u>						
	Salmon SU	Snow SU	JCL SU	Union SU	Lilliwaup SU	Hamma Hamma SU	Duckabush SU	Dosewallips SU	Big Beef SU	Big Quilcene R/Bay SU
<i>mIDHP-1</i>										
(N)	150	50	206	368	188	230	131	151	81	363
100	0.860	0.900	0.913	0.867	0.926	0.850	0.847	0.861	0.914	0.912
60	0.140	0.100	0.087	0.133	0.074	0.148	0.153	0.139	0.086	0.088
140	/	/	/	/	/	0.002	/	/	/	/
<i>sIDHP-1</i>										
(N)	150	50	207	288	187	230	131	152	83	366
100	1.000	1.000	0.998	0.984	0.984	0.985	0.989	0.997	0.994	0.984
70	/	/	0.002	0.016	0.016	0.015	0.011	0.003	0.006	0.016
<i>sIDHP-2</i>										
(N)	150	50	207	368	188	230	131	152	83	366
100	0.443	0.510	0.517	0.577	0.622	0.620	0.603	0.589	0.669	0.585
35	0.403	0.330	0.324	0.289	0.314	0.267	0.263	0.332	0.223	0.287
85	0.023	0.000	0.106	0.058	0.051	0.087	0.092	0.069	0.102	0.109
25	0.130	0.160	0.048	0.073	0.013	0.022	0.042	0.010	0.006	0.019
20	/	/	/	1.000	/	/	/	/	/	/
28	/	/	0.005	/	/	0.002	/	/	/	/
45	/	/	/	/	/	0.002	/	/	/	/
<i>sMDH-A1</i>										
(N)	149	50	207	366	188	228	130	151	83	363
100	0.903	0.910	0.959	0.937	0.920	0.921	0.846	0.901	0.861	0.886
200	0.097	0.090	0.041	0.063	0.080	0.079	0.154	0.099	0.139	0.114
400	/	/	/	/	/	/	/	/	/	/
<i>sMDH-B1,2</i>										
(N)	147	50	208	366	188	230	131	152	82	365
100	0.988	1.000	0.996	0.981	0.980	0.972	0.975	0.975	0.963	0.962
72	0.012	/	0.004	0.019	0.020	0.028	0.025	0.025	0.037	0.038
130	/	/	/	/	/	/	/	/	/	/
<i>mMEP-2</i>										
(N)	150	50	209	368	188	229	131	152	83	366
100	0.943	0.950	0.928	0.810	0.904	0.913	0.882	0.872	0.904	0.925
110	0.057	0.050	0.072	0.190	0.096	0.087	0.118	0.125	0.096	0.075
75	/	/	/	/	/	/	/	0.003	/	/
<i>MPI</i>										
(N)	148	50	208	368	188	228	131	152	83	366
100	0.615	0.620	0.683	0.693	0.606	0.649	0.668	0.641	0.687	0.619
92	0.385	0.380	0.317	0.307	0.394	0.351	0.332	0.359	0.313	0.381

	<u>St of Juan de Fuca SU</u>			<u>Hood Canal SU</u>						
	Salmon SU	Snow SU	JCL SU	Union SU	Lilliwaup SU	Hamma Hamma SU	Duckabush SU	Dosewallips SU	Big Beef SU	Big Quilcene R/Bay SU
<i>PEPB-1</i>										
(N)	148	50	208	357	186	209	131	135	82	362
100	0.801	0.730	0.714	0.636	0.516	0.701	0.672	0.667	0.610	0.681
146	0.098	0.130	0.096	0.115	0.073	0.065	0.088	0.033	0.104	0.058
126	0.071	0.110	0.118	0.162	0.239	0.096	0.073	0.259	0.165	0.120
127	0.030	0.030	0.072	0.087	0.172	0.139	0.168	0.041	0.122	0.141
72	/	/	/	/	/	/	/	/	/	/
50	/	/	/	/	/	/	/	/	/	/

	<u>Hood Canal SU</u>		<u>Hood Canal F</u>		<u>Sinclair Inlet - Colvos Passage Puget Sound SU</u>			<u>Puget Sound SU/F</u>		
	Quilcene NFH SU	Little Quilcene SU	Hood Canal FH F '85	Hood Canal FH F '86	Blackjack SU '85	Blackjack SU '96	Curley '02	Chico F '85	Chico F '89	Gorst SU '85
<i>mAAT-1</i>										
(N)	154	29	60	100	100	100	100	100	95	100
100	0.614	0.621	0.633	0.615	0.770	0.795	0.740	0.695	0.732	0.685
120	0.386	0.379	0.367	0.385	0.230	0.205	0.255	0.285	0.253	0.315
70	/	/	/	/	/	/	0.005	0.020	0.016	/
<i>sAAT-1,2</i>										
(N)	154	30	100	100	100	100	100	100	96	100
100	0.964	0.975	0.888	0.898	0.868	0.905	0.868	0.880	0.857	0.860
120	0.036	0.025	0.113	0.102	0.132	0.095	0.132	0.120	0.143	0.140
65	/	/	/	/	/	/	/	/	/	/
<i>sAAT-3</i>										
(N)	153	21	0	45	0	95	100	0	96	100
100	0.709	0.738		0.678		0.674	0.655		0.719	0.675
90	0.271	0.262		0.322		0.326	0.340		0.281	0.325
110	/	/		/		/	0.005		/	/
70	0.020	/		/		/	/		/	/
<i>mAH-3</i>										
(N)	149	27	100	100	99	100	100	100	96	100
100	0.534	0.389	0.365	0.345	0.333	0.340	0.395	0.360	0.333	0.305
124	0.466	0.611	0.635	0.655	0.667	0.660	0.605	0.640	0.661	0.695
115	/	/	/	/	/	/	/	/	0.005	/
<i>ALAT</i>										
(N)	154	30	100	100	100	100	100	100	96	100
100	0.903	0.850	0.865	0.865	0.845	0.820	0.815	0.810	0.865	0.865
93	0.097	0.150	0.105	0.095	0.140	0.160	0.165	0.165	0.109	0.125
105	/	/	0.030	0.035	0.015	0.020	0.020	0.025	0.026	0.010
98	/	/	/	0.005	/	/	/	/	/	/
78	/	/	/	/	/	/	/	/	/	/
<i>ESTD-2</i>										
(N)	154	27	0	0	0	100	100	0	0	0
100	0.961	0.907				0.960	0.860			
87	0.039	0.093				0.040	0.140			
<i>G3PDH-2</i>										
(N)	154	23	100	100	100	100	100	100	96	100
100	0.870	0.739	0.835	0.805	0.790	0.785	0.800	0.890	0.932	0.895
90	0.130	0.261	0.165	0.195	0.210	0.215	0.165	0.110	0.068	0.105
131	/	/	/	/	/	/	0.035	/	/	/

	<u>Hood Canal SU</u>		<u>Hood Canal F</u>		<u>Sinclair Inlet - Colvos Passage Puget Sound SU</u>			<u>Puget Sound SU/F</u>		
	Quilcene NFH SU	Little Quilcene SU	Hood Canal FH F '85	Hood Canal FH F '86	Blackjack SU '85	Blackjack SU '96	Curley '02	Chico F '85	Chico F '89	Gorst SU '85
<i>mIDHP-1</i>										
(N)	154	30	100	100	100	100	100	100	96	100
100	0.883	0.850	0.680	0.710	0.870	0.855	0.890	0.755	0.813	0.740
60	0.117	0.150	0.320	0.290	0.130	0.145	0.110	0.245	0.188	0.260
140	/	/	/	/	/	/	/	/	/	/
<i>sIDHP-1</i>										
(N)	154	27	100	100	100	100	100	99	96	100
100	0.997	0.981	0.990	1.000	1.000	1.000	0.985	1.000	1.000	1.000
70	0.003	0.019	0.010	/	/	/	0.015	/	/	/
<i>sIDHP-2</i>										
(N)	154	27	100	100	99	100	100	98	96	100
100	0.568	0.556	0.625	0.615	0.449	0.465	0.510	0.459	0.448	0.410
35	0.318	0.389	0.245	0.235	0.429	0.435	0.355	0.383	0.406	0.335
85	0.104	0.056	0.095	0.075	0.106	0.070	0.095	0.117	0.104	0.210
25	0.010	0.000	0.035	0.075	0.015	0.030	0.040	0.041	0.042	0.045
20	/	/	/	/	/	/	/	/	/	/
28	/	/	/	/	/	/	/	/	/	/
45	/	/	/	/	/	/	/	/	/	/
<i>sMDH-A1</i>										
(N)	154	26	100	100	100	100	100	100	96	100
100	0.883	0.904	0.980	0.980	0.995	1.000	0.980	0.940	0.964	0.915
200	0.117	0.096	0.020	0.020	0.005	0.000	0.020	0.060	0.036	0.085
400	/	/	/	/	/	/	/	/	/	/
<i>sMDH-B1,2</i>										
(N)	151	27	100	100	100	100	100	100	96	100
100	0.985	0.972	0.995	0.998	0.993	0.993	0.998	0.995	0.995	1.000
72	0.015	0.028	0.005	0.002	0.007	0.007	0.002	0.005	0.005	/
130	/	/	/	/	/	/	/	/	/	/
<i>mMEP-2</i>										
(N)	154	30	100	100	100	100	99	100	96	100
100	0.945	0.883	0.800	0.745	0.835	0.795	0.803	0.755	0.745	0.735
110	0.055	0.117	0.195	0.255	0.160	0.205	0.197	0.245	0.255	0.265
75	/	/	0.005	/	0.005	/	/	/	/	/
<i>MPI</i>										
(N)	154	29	100	100	100	100	100	100	96	100
100	0.601	0.603	0.890	0.850	0.810	0.685	0.775	0.760	0.682	0.760
92	0.399	0.397	0.110	0.150	0.190	0.315	0.225	0.240	0.318	0.240

	<u>Hood Canal SU</u>		<u>Hood Canal F</u>		Sinclair Inlet - Colvos Passage <u>Puget Sound SU</u>			<u>Puget Sound SU/F</u>		
	Quilcene NFH SU	Little Quilcene SU	Hood Canal FH F '85	Hood Canal FH F '86	Blackjack SU '85	Blackjack SU '96	Curley '02	Chico F '85	Chico F '89	Gorst SU '85
<i>PEPB-1</i>										
(N)	149	26	99	100	100	97	97	100	96	98
100	0.688	0.769	0.611	0.565	0.690	0.686	0.696	0.755	0.745	0.750
146	0.087	0.038	0.192	0.255	0.100	0.077	0.103	0.070	0.099	0.066
126	0.064	0.058	0.111	0.085	0.125	0.149	0.139	0.110	0.094	0.112
127	0.161	0.135	0.086	0.095	0.085	0.088	0.062	0.065	0.063	0.071
72	/	/	/	/	/	/	/	/	/	/
50	/	/	/	/	/	/	/	/	/	/

Puget Sound SU/F

	Blackjack F '98	Ollala F '93	Coulter SU '85	Sherwood SU '85	Sherwood SU '94	Sherwood F '85	Sherwood F '94	Johns SU '85	Johns SU '94
<i>mAAT-1</i>									
(N)	100	98	100	100	98	106	100	100	100
100	0.650	0.694	0.655	0.565	0.628	0.660	0.640	0.600	0.630
120	0.290	0.265	0.340	0.425	0.347	0.330	0.345	0.400	0.370
70	0.060	0.041	0.005	0.010	0.026	0.009	0.015	/	/
<i>sAAT-1,2</i>									
(N)	100	100	100	100	98	106	100	100	100
100	0.883	0.910	0.860	0.875	0.903	0.887	0.883	0.900	0.883
120	0.117	0.090	0.140	0.125	0.097	0.113	0.117	0.100	0.117
65	/	/	/	/	/	/	/	/	/
<i>sAAT-3</i>									
(N)	98	99	99	0	98	0	98	98	98
100	0.673	0.692	0.692		0.699		0.786	0.668	0.694
90	0.327	0.308	0.308		0.301		0.214	0.332	0.306
110	/	/	/		/		/	/	/
70	/	/	/		/		/	/	/
<i>mAH-3</i>									
(N)	99	97	83	98	97	106	100	100	99
100	0.288	0.299	0.289	0.230	0.320	0.311	0.255	0.305	0.313
124	0.712	0.701	0.711	0.770	0.680	0.689	0.735	0.695	0.687
115	/	/	/	/	/	/	0.010	/	/
<i>ALAT</i>									
(N)	100	100	100	100	98	106	100	100	100
100	0.765	0.880	0.760	0.840	0.857	0.835	0.835	0.745	0.725
93	0.200	0.095	0.205	0.150	0.128	0.142	0.135	0.200	0.205
105	0.035	0.025	0.035	0.010	0.015	0.024	0.030	0.055	0.070
98	/	/	/	/	/	/	/	/	/
78	/	/	/	/	/	/	/	/	/
<i>ESTD-2</i>									
(N)	100	96	0	0	98	0	100	0	99
100	0.955	0.901			0.969		0.940		0.848
87	0.045	0.099			0.031		0.060		0.152
<i>G3PDH-2</i>									
(N)	90	98	100	100	73	106	100	100	97
100	0.906	0.903	0.920	0.935	0.938	0.863	0.940	0.930	0.923
90	0.094	0.097	0.080	0.065	0.062	0.137	0.055	0.070	0.077
131	/	/	/	/	/	/	0.005	/	/

Puget Sound SU/F

	Blackjack F '98	Ollala F '93	Coulter SU '85	Sherwood SU '85	Sherwood SU '94	Sherwood F '85	Sherwood F '94	Johns SU '85	Johns SU '94
<i>mDHP-1</i>									
(N)	100	93	100	100	98	106	100	100	100
100	0.795	0.823	0.720	0.790	0.745	0.731	0.800	0.770	0.760
60	0.200	0.177	0.280	0.210	0.255	0.269	0.200	0.230	0.240
140	0.005	/	/	/	/	/	/	/	/
<i>sIDHP-1</i>									
(N)	100	100	75	100	98	105	100	100	100
100	0.995	1.000	1.000	1.000	1.000	0.990	0.995	0.995	0.990
70	0.005	/	/	/	/	0.010	0.005	0.005	0.010
<i>sIDHP-2</i>									
(N)	100	98	100	100	98	104	100	100	96
100	0.460	0.556	0.545	0.570	0.505	0.577	0.515	0.535	0.531
35	0.375	0.230	0.330	0.250	0.296	0.216	0.305	0.285	0.281
85	0.085	0.143	0.110	0.120	0.153	0.135	0.090	0.170	0.167
25	0.080	0.071	0.015	0.055	0.046	0.067	0.090	0.010	0.021
20	/	/	/	/	/	/	/	/	/
28	/	/	/	0.005	/	0.005	/	/	/
45	/	/	/	/	/	/	/	/	/
<i>sMDH-A1</i>									
(N)	100	100	100	100	98	106	100	100	100
100	0.970	0.945	0.955	0.935	0.980	0.958	0.945	0.970	0.995
200	0.030	0.055	0.045	0.060	0.020	0.038	0.050	0.030	0.005
400	/	/	/	0.005	/	0.005	0.005	/	/
<i>sMDH-B1,2</i>									
(N)	100	100	100	100	98	106	100	100	99
100	0.995	1.000	0.995	1.000	0.990	0.995	0.995	1.000	0.997
72	0.005	/	0.005	/	0.010	0.005	0.005	/	0.003
130	/	/	/	/	/	/	/	/	/
<i>mMEP-2</i>									
(N)	100	99	100	100	98	106	100	98	100
100	0.700	0.667	0.830	0.745	0.745	0.741	0.725	0.791	0.780
110	0.300	0.333	0.170	0.255	0.255	0.259	0.275	0.209	0.220
75	/	/	/	/	/	/	/	/	/
<i>MPI</i>									
(N)	100	98	100	100	98	106	100	100	100
100	0.750	0.796	0.740	0.700	0.770	0.792	0.730	0.905	0.875
92	0.250	0.204	0.260	0.300	0.230	0.208	0.270	0.095	0.125

Puget Sound SU/F

	Blackjack F '98	Ollala F '93	Coulter SU '85	Sherwood SU '85	Sherwood SU '94	Sherwood F '85	Sherwood F '94	Johns SU '85	Johns SU '94
<i>PEPB-1</i>									
(N)	99	97	100	100	98	106	100	100	100
100	0.783	0.742	0.715	0.660	0.724	0.703	0.645	0.695	0.645
146	0.071	0.077	0.085	0.165	0.087	0.160	0.170	0.180	0.165
126	0.071	0.072	0.125	0.050	0.107	0.085	0.100	0.070	0.090
127	0.076	0.108	0.075	0.125	0.082	0.052	0.085	0.055	0.100
72	/	/	/	/	/	/	/	/	/
50	/	/	/	/	/	/	/	/	/

	<u>Puget Sound SU/F</u>		<u>Strait of Georgia</u>		<u>Fraser River</u>	
	Johns FH F '85	Elson FH F '85	Chemainus F '88	Goldstream F '87	Weaver F '88	Harrison F '92
<i>mAAT-1</i>						
(N)	100	100	99	100	100	100
100	0.605	0.580	0.682	0.595	0.710	0.660
120	0.370	0.400	0.318	0.405	0.290	0.340
70	0.025	0.020	/	/	/	/
<i>sAAT-1,2</i>						
(N)	100	100	100	100	100	100
100	0.880	0.885	0.875	0.888	0.852	0.845
120	0.120	0.115	0.123	0.112	0.148	0.155
65	/	/	0.002	/	/	/
<i>sAAT-3</i>						
(N)	100	30	0	99	0	99
100	0.705	0.750		0.677		0.677
90	0.295	0.250		0.323		0.323
110	/	/		/		/
70	/	/		/		/
<i>mAH-3</i>						
(N)	97	100	100	82	75	100
100	0.345	0.320	0.335	0.348	0.373	0.405
124	0.655	0.680	0.665	0.652	0.627	0.595
115	/	/	/	/	/	/
<i>ALAT</i>						
(N)	99	99	100	100	100	98
100	0.884	0.828	0.790	0.860	0.720	0.770
93	0.116	0.126	0.210	0.135	0.230	0.153
105	/	0.045	/	/	0.050	0.077
98	/	/	/	/	/	/
78	/	/	/	0.005	/	/
<i>ESTD-2</i>						
(N)						
100	0	0	0	0	0	97
87						0.933 0.067
<i>G3PDH-2</i>						
(N)	100	100	100	99	100	98
100	0.925	0.935	0.960	0.960	0.935	0.934
90	0.075	0.065	0.040	0.040	0.065	0.066
131	/	/	/	/	/	/

	<u>Puget Sound SU/F</u>		<u>Strait of Georgia</u>		<u>Fraser River</u>	
	Johns FH F '85	Elson FH F '85	Chemainus F '88	Goldstream F '87	Weaver F '88	Harrison F '92
<i>mIDHP-1</i>						
(N)	100	100	100	100	97	97
100	0.870	0.835	0.955	0.925	0.912	0.943
60	0.130	0.165	0.045	0.070	0.088	0.057
140	/	/	/	0.005	/	/
<i>sIDHP-1</i>						
(N)	100	100	100	100	100	100
100	1.000	1.000	1.000	1.000	0.985	0.985
70	/	/	/	/	0.015	0.015
<i>sIDHP-2</i>						
(N)	100	100	99	100	100	99
100	0.430	0.430	0.540	0.600	0.635	0.556
35	0.295	0.310	0.318	0.290	0.235	0.278
85	0.200	0.210	0.040	0.035	0.065	0.071
25	0.075	0.050	0.101	0.075	0.065	0.086
20	/	/	/	/	/	/
28	/	/	/	/	/	/
45	/	/	/	/	/	0.010
<i>sMDH-A1</i>						
(N)	100	100	100	100	100	100
100	0.960	0.945	1.000	0.995	0.975	0.990
200	0.040	0.055	0.000	0.005	0.025	0.010
400	/	/	/	/	/	/
<i>sMDH-B1,2</i>						
(N)	100	100	100	100	100	98
100	1.000	1.000	1.000	0.998	0.983	0.997
72	/	/	/	/	0.018	0.003
130	/	/	/	0.002	/	/
<i>mMEP-2</i>						
(N)	100	95	100	100	100	100
100	0.775	0.753	0.835	0.715	0.850	0.905
110	0.225	0.247	0.165	0.285	0.150	0.095
75	/	/	/	/	/	/
<i>MPI</i>						
(N)	100	100	100	100	100	100
100	0.855	0.830	0.870	0.880	0.870	0.885
92	0.145	0.170	0.130	0.120	0.130	0.115

	<u>Puget Sound SU/F</u>		<u>Strait of Georgia</u>		<u>Fraser River</u>	
	Johns FH F '85	Elson FH F '85	Chemainus F '88	Goldstream F '87	Weaver F '88	Harrison F '92
<i>PEPB-1</i>						
(N)	100	96	100	99	100	99
100	0.695	0.693	0.650	0.596	0.640	0.712
146	0.170	0.172	0.240	0.187	0.165	0.146
126	0.110	0.089	0.095	0.167	0.130	0.086
127	0.025	0.047	0.010	0.045	0.065	0.056
72	/	/	/	0.005	/	/
50	/	/	0.005	/	/	/

# ***APPENDIX REPORT 4***

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## ***A GENETIC ANALYSIS OF SUMMER AND FALL CHUM SALMON POPULATIONS IN HOOD CANAL, STRAIT OF JUAN DE FUCA, AND SOUTH PUGET SOUND USING MICROSATELLITE DNA***

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## Abstract

Chum salmon are notable among Pacific salmonids for their limited residence in fresh water and their range of residence times in salt water. Since year classes overlap in this species, geographic proximity and run timing serve as barriers to gene flow. In this study, we compared genetic relationships among chum salmon collections in three geographic areas; Hood Canal, Strait of Juan de Fuca and South Puget Sound with either summer or fall run timing. Allele frequencies at 17 microsatellite loci separated these collections into four groups based upon geography and run-timing. Hood Canal summer-run collections formed a group distinct from but associated with Strait of Juan de Fuca summer-run collections, these summer-run collections were distinct from Hood Canal fall-run collections and from South Puget Sound summer-run collections.

## Introduction

Chum salmon in Washington State have been divided into three regional groups based upon genetic and ecological criteria; Coastal, Columbia River and Puget Sound regions (Johnson *et al.* 1997). Within the Puget Sound region, Hood Canal (HC) and Strait of Juan de Fuca (SJF) summer-run chum salmon have been identified further as genetically (Phelps *et al.* 1994) and ecologically unique (Johnson *et al.* 1997). With the earliest run timing in Puget Sound, HC and SJF summer chum salmon are adapted to a suite of ecological conditions (smaller drainages, warmer water, lower flow) associated with summer spawning (Johnson *et al.* 1997). Based upon genetic and ecological data, HC and SJF summer chum salmon were deemed an evolutionarily significant unit (ESU), an important component of the evolutionary legacy of chum salmon in Washington State (Johnson *et al.* 1997). HC and SJF summer chum salmon have become a group of interest since the populations collapsed in the early 1990's to a total escapement of 767 in 1993, and remained depressed throughout the 1990's. In response to this prolonged collapse, HC and SJF summer chum became listed under the Endangered Species Act in 1999. Hatchery production in HC and SJF, inactive or intermittent since the 1930's, was restarted in 1992 as part of the effort to restore wild populations. WDFW is developing a microsatellite DNA genetic baseline of HC and SJF summer chum salmon, as well as other Puget Sound chum salmon stocks, to monitor effects of supplementation by tracking genetic changes, and to insure that genetic diversity and stock heterogeneity are maintained. The baseline will be a management and enforcement tool. WDFW will be able to identify components of a mixed stock fishery in the Strait of Juan de Fuca and determine whether endangered HC and SJF summer chum salmon enter the Strait of Juan de Fuca mingled with healthy South Puget Sound (SPS) summer chum stocks. If some fisheries are closed, individuals may be identified as members of a closed or open fishery.

## Methods and Results

Genotypes were assessed at 18 microsatellite loci (Table 1) for 829 individuals in 16 collections (Table 2). Collections consisted of summer-run chum salmon from Hood Canal (HCS), Strait of Juan de Fuca (SJFS), South Puget Sound (SPSS) and fall-run chum salmon from Hood Canal (HCF, see Figure 1 for map). Table 2 lists collections, number of fish analyzed and population codes used in WDFW genetics laboratory. Loci and collections were tested for deficits of heterozygotes and homozygotes (Hardy-Weinberg equilibrium, HWE) across all loci and across all collections using FSTAT 2.9.3 (Goudet 2001) and GENEPOP version 3.3 (Raymond and Rousset 1995). Hardy-Weinberg equilibrium describes the proportions of genotypes that should be found in a collection if there is no selection, mutation, recent mixing of populations, and if the population size is large over several generations so there is little inbreeding or recent genetic bottleneck. Deviations from HWE indicate that perturbing processes have occurred. Results for all tests were adjusted for multiple comparisons to an alpha level of 0.05. Linkage disequilibrium (over all collections) was detected in 20 pairwise comparisons of loci indicating some non-independence of loci (alleles at one locus were associated with alleles at another locus). In disequilibrium tests within collections, the greatest disequilibrium (21 pairs) was detected in the Jimmycomelately collection (Table 2). This extraordinary disequilibrium could have arisen from a severe bottleneck the previous generation since the collection was in HWE (Table 2): random assortment has not yet mixed allele combinations present in the few parents yet

HWE can be established within a single generation. Only two linkages were shared: two of the same linkages occurred in Jimmycomelately and Salmon/Snow, possibly due to fish from same family groups dispersing between the two rivers. Since different loci pairs were in disequilibrium in different collections, loci were likely associated due to inbreeding or recent bottlenecks rather than being physically linked (close together on the same chromosome). No homozygote deficits were detected in any analysis. In tests over all collections, heterozygote deficit was detected in six loci (*One-101*, *Omm-1137*, *One-114*, *Ots-G311*, *One-108* and *Ots-103*, Table 1), also suggesting inbreeding or recent bottlenecks. *Omm-1137* was out of HWE in 10 collections and was dropped from the rest of the analysis. The remaining loci were out of HWE in less than half the collections. In collection tests, all SPSS and HCF collections as well as Dosewallips, Duckabush and 97Quilcene were out of HWE for heterozygote deficits (Table 2). Positive  $F_{is}$  values (correlation of alleles within individuals) in most collections and significant  $F_{is}$  values in several collections suggested that most collections have experienced inbreeding or small effective population sizes. Although population numbers are up from the lows sustained throughout the 1990's, some disequilibrium remains.

We conducted pairwise genotypic tests using GENEPOP to determine if collections differed in genotype frequencies (Table 3). In this test, a contingency table of genotypes is constructed and a  $\chi^2$  test is performed to determine if genotype frequencies differ between collections. Most comparisons within the HCS collections indicated close genetic relationships with little difference in genotype frequencies: Quilcene, Duckabush, Dosewallips and Hamma Hamma were undifferentiated from each other. The HCF collections, Hoodport Hatchery and Dewatto were also undifferentiated, as were two of the SPSS (John's Hatchery and Coulter Cr Hatchery). Within the HCS collections, Union and Lilliwaup were different from all the other collections (Table 3).

Pairwise chord distances (Cavalli-Sforza and Edwards 1967) among collections were generated from allele frequency data using Microsatellite Analyzer (MSA, Dieringer and Schlötterer 2002). A dendrogram illustrating genetic relationships was constructed from pairwise chord distances using the neighbor-joining (NJ) algorithm in the program NEIGHBOR in PHYLIP (Felsenstein 1993). To test the repeatability of tree branching, 1,000 bootstrap replicates of the pairwise chord distances were generated using MSA. Tree topologies were created for all replicates using NEIGHBOR and a consensus tree was generated in CONSENSE in PHYLIP. The dendrogram identified two major clusters with bootstrap support of 100% (Figure 2); HCS and SJFS formed one cluster and HCF and SPSS formed the other cluster. These clusters divided further into four constituent groups, HCS (88% support), SJFS (100% support), HCF (92% support) and SPSS (100% support, Figure 2). Within HCS, Duckabush, Dosewallips, Hamma Hamma and the Quilcene collections formed a branch with 90% bootstrap support. A multidimensional scaling analysis was performed upon the Cavalli-Sforza and Edwards pairwise distances using NTSYS (Rohlf 1993, Figure 3). The groupings were similar to those in the NJ dendrogram analysis. HCS and SJFS separate from HCF and SPSS along the 1<sup>st</sup> axis and the constituent groups separate from each other along the 2<sup>nd</sup> and 3<sup>rd</sup> axes. Microsatellite analysis reiterated the groups identified by allozyme analysis (Phelps et al. 1994) and increased the resolution: although associated with HCS, SJFS formed their own highly supported group.

The program WHICHRUN 4.2 (Banks and Eichert 2000) was used to assign fish to a collection (Table 4). The program implements a jackknife procedure where each fish in turn is removed from the dataset, allele frequencies of the baseline (all the collections in the dataset) are calculated and the fish is assigned to the most likely collection based upon its genotype and the allele frequencies of the collections. With the exception of Duckabush, Dosewallips, Hamma Hamma and 92Quilcene, assignments for collections were significantly greater than expected by chance (Table 4). In regional analyses (Table 5, under regional collections), collections from regions identified by the NJ analysis were grouped together and correct assignments to each regional group were above 84%, all greater than expected by chance ( $P$  values for  $\chi^2$  tests  $< 0.05$ , Table 5). This indicates that regional groups are genetically distinct, that regional components

in a mixed fishery could be identified, and that individuals could be assigned to their region of origin. If only HCS collections were analyzed (Table 5, under Hood Canal only), only fish from Union and Lilliwaup, stocks rated by WDFW *et al.* (in prep.) respectively as healthy and critical, had a high probability of assignment to their collection of origin. Fish from Hamma Hamma, Quilcene, Duckabush and Dosewallips, rated as depressed by WDFW *et al.* (in prep), were distributed among these four collections, underscoring the close genetic relationship among them. In a fishery within Hood Canal, fish would be correctly identified as originating from the depressed stocks, from Union or from Lilliwaup. If the fishery were extended to include SJFS, fish from the Strait of Juan de Fuca would be confidently separated from HCS (Table 5 under Hood Canal and SJF). In sum, these results indicate that microsatellite DNA analysis will be able to identify components of mixed-stock fisheries in the Strait of Juan de Fuca and within Hood Canal, to identify individual fish as originating from critical, depressed or healthy stocks, and to identify individual fish to region.

The genetic baseline will also be useful for enforcement. We analyzed genetically 16 juveniles that had been stranded by low water in the Skokomish River. Microsatellite analysis indicated that they were not chum salmon and mtDNA analysis identified them as pink salmon. We also used WHICHRUN to analyze two unknown fish collected in Hood Canal. Each locus was dropped out in turn to examine the influence of a single locus on the assignment of an unknown individual. One fish appears to have originated in the Quilcene population: 9/12 tests indicated Quilcene, 2/12 indicated Duckabush and 1/12 indicated Hamma Hamma. The other fish appears to have originated in the Duckabush population: 10/12 tests indicated Duckabush and 2/12 indicated Quilcene. Since these populations are weakly differentiated, we can conclude that these unknown fish were from depressed populations rather than from Union, the healthy population or Lilliwaup, the critical population.

### Conclusions

Run-timing and geographic proximity interact to influence genetic structure in chum salmon within the Puget Sound region. Summer-run chum salmon from Hood Canal are reproductively isolated from fall-run chum salmon in Hood Canal and summer-run chum salmon in South Puget Sound. Gene flow is also restricted between summer-run chum salmon from Hood Canal and the Strait of Juan de Fuca. Because of this reproductive isolation, each group is genetically distinct. Using microsatellite DNA analysis, individual fish can be assigned to their region of origin and components of a mixed stock fishery may be identified in future studies. Genetic analysis indicates that Hood Canal and Strait of Juan de Fuca summer chum collections have not yet recovered from the population depressions sustained during the 1990's; collections still show evidence of inbreeding, a result of low effective population sizes.

## References

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Table 1. Statistics for loci used in genetic characterization of chum salmon. Allele size range (range) is given in number of basepairs. Most statistics were calculated using FSTAT, observed heterozygosity is under Ho column, gene diversity (Ht) is the expected heterozygosity, Dst' is the amount of diversity among samples independent of sample size, Gst' is an estimate of Fst (a measure of population subdivision) and Gis is an estimate of Fis (correlation of alleles within individuals). Under HWE (P) column is the P value for a deficit of expected heterozygotes tested using GENEPOP. Loci in bold type were out of HWE.

Loci	# alleles	range	Ho	Ht	Dst'	Gst'	Gis	HWE (P)
<i>Oke-3</i>	8	340-442	0.62	0.644	0.05	0.078	-0.038	0.6161
<i>Ots-3M</i>	13	130-160	0.659	0.7	0.021	0.03	0.031	0.094
<i>Ots-1</i>	17	115-240	0.744	0.773	0.026	0.033	0.008	0.0112
<b><i>One-101</i></b>	<b>33</b>	<b>117-264</b>	<b>0.791</b>	<b>0.922</b>	<b>0.032</b>	<b>0.035</b>	<b>0.113</b>	<b>0</b>
<b><i>Omm-1137</i></b>	<b>23</b>	<b>96-152</b>	<b>0.795</b>	<b>0.929</b>	<b>0.021</b>	<b>0.023</b>	<b>0.126</b>	<b>0</b>
<i>Oki-1</i>	16	174-246	0.851	0.866	0.025	0.029	-0.01	0.7852
<i>Omm-1138</i>	16	273-309	0.645	0.688	0.017	0.025	0.041	0.0586
<i>Ots-2M</i>	6	143-158	0.519	0.522	0.02	0.038	-0.03	0.1261
<b><i>One-114</i></b>	<b>29</b>	<b>176-292</b>	<b>0.823</b>	<b>0.9</b>	<b>0.035</b>	<b>0.038</b>	<b>0.051</b>	<b>0</b>
<i>One-102</i>	21	215-300	0.887	0.922	0.011	0.012	0.026	0.0204
<b><i>Ots-G311</i></b>	<b>53</b>	<b>240-485</b>	<b>0.851</b>	<b>0.96</b>	<b>0.031</b>	<b>0.032</b>	<b>0.086</b>	<b>0</b>
<i>One-18</i>	6	160-177	0.645	0.696	0.036	0.051	0.026	0.0472
<i>Omy-1011</i>	14	183-242	0.833	0.867	0.022	0.025	0.017	0.0058
<i>One-106</i>	48	177-333	0.917	0.951	0.019	0.02	0.018	0.033
<i>Ssa-419</i>	13	258-306	0.765	0.79	0.011	0.013	0.019	0.1416
<i>One-111</i>	60	169-333	0.9	0.933	0.02	0.021	0.016	0.1099
<b><i>One-108</i></b>	<b>45</b>	<b>154-331</b>	<b>0.892</b>	<b>0.954</b>	<b>0.027</b>	<b>0.028</b>	<b>0.039</b>	<b>0</b>
<b><i>Ots-103</i></b>	<b>36</b>	<b>98-262</b>	<b>0.833</b>	<b>0.945</b>	<b>0.039</b>	<b>0.041</b>	<b>0.083</b>	<b>0</b>
mean	25.38							
All			0.763	0.825	0.026	0.031	0.048	0.00

Table 2. Statistics for Hood Canal, Strait of Juan de Fuca and South Puget Sound chum salmon collections. FSTAT was used to test collections for correlations of alleles in individuals in relation to the total data set (Fis values), to estimate expected heterozygosity corrected for population size (mean gene div), and to estimate the number of alleles independent of sample size (mean allelic rich). GENEPOP was used to test for deficit of heterozygotes in HWE tests. Under “HWE *P*” is the *P* value for conformance to HWE expectations. The “Region” column indicates the geographic region and the run-timing for the collection: HCS = Hood Canal summer run, SJFS = Strait of Juan de Fuca summer run, HCF = Hood Canal fall run and SPSS = South Puget Sound summer run. The number of linkage disequilibria detected in the collection is indicated in the “#dis” column.

Code	Collection	Region	#dis	N	Fis	<i>P</i> value	HWE <i>P</i>	Mean gene div	Mean allelic rich
00EF	00Union	HCS	1	54	0.021	0.086	0.0248	0.757	4.866
00GA	00Dosewallips	HCS	1	58	0.046	0.0018	0	0.777	5.196
00GB	00Duckabush	HCS		48	0.043	0.0041	0	0.778	5.153
01GV	01Hamma Hamma	HCS	3	56	0.007	0.3139	0.6912	0.775	5.182
01GW	01Lilliwaup	HCS	6	53	0.016	0.1376	0.1199	0.761	5.068
92GB	92Quilcene	HCS		50	-0.006	0.6515	0.0449	0.807	5.381
97DS	97Quilcene	HCS		54	0.027	0.0332	0	0.770	5.063
00GD	00Salmon/Snow	SJFS	5	60	0.026	0.0315	0.0144	0.780	5.014
01GJ	01Jimmycomelately	SJFS	21	60	0.007	0.3346	0.5888	0.751	4.803
98JN	98Hoodsport Hatchery	HCF		52	0.036	0.0046	0	0.793	5.445
98JR	98Dewatto	HCF	2	59	0.016	0.1433	0	0.791	5.381
02KF	02Mission	HCF	5	18	0.041	0.07	0	0.775	5.196
94GP	94John's Cr Hatchery	SPSS	1	55	0.059	0.0001	0	0.780	5.267
94GR	94Sherwood	SPSS		55	0.066	0	0	0.778	5.269
94GT	94Coulter Cr Hatchery	SPSS		56	0.087	0	0	0.788	5.404
96CO	96Blackjack	SPSS	5	41	0.087	0	0	0.757	4.961
	All			829	0.04			0.774	5.503

Table 3. Pairwise genotypic test results. Collections were tested for significant differences in genotype distributions using GENEPOP. *P* values for comparisons that were insignificant ( $P > 0.00042$ ) are in bold. Zero *P* values are indicated by a dash.

	00Union	00Dose	00Duck	01Hamma	01Lilli	92Quil	97Quil	00SalSno	01Jimmy	98Hood	98Dewatt	02Mission	94Johns	94Sherw	94Coul	96Blackj
00Union	-															
00Dose	-															
00Duck	-	<b>0.47483</b>														
01Hamma	-	<b>0.03507</b>	<b>0.00637</b>													
01Lilli	-	-	-	-												
92Quil	-	0.00008	<b>0.0279</b>	<b>0.00527</b>	-											
97Quil	-	<b>0.00283</b>	<b>0.0099</b>	<b>0.21126</b>	-	<b>0.4436</b>										
00SalSno	-	-	-	-	-	-	-									
01Jimmy	-	-	-	-	-	-	-	-								
98Hood	-	-	-	-	-	-	-	-	-							
98Dewatt	-	-	-	-	-	-	-	-	<b>0.00059</b>							
02Mission	-	-	-	-	-	-	-	-	-	0.00013						
94Johns	-	-	-	-	-	-	-	-	-	-	-					
94Sherw	-	-	-	-	-	-	-	-	-	-	-	-		0.00002		
94Coul	-	-	-	-	-	-	-	-	-	-	-	-	-	<b>0.00288</b>	0.00027	
96Blackj	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4. Table of assignments using WHICHRUN with all collections (except 02Mission) in the baseline. Individual fish were given the most likely assignment to a collection based upon the genotype of the fish and the allele frequencies in the collections. Assignments back to collection of origin and significant  $\chi^2$  test values are in bold type

	N	00Union	00Dose	00Duck	01Hamma	01Lilli	92Quil	97Quil	00SalSno	01Jimmy	98HoodH	98Dewatt	02Mission	94JohnsC	94Sherwo	94Coulter	96Black
00Union	54	<b>52</b>	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-
00Dose	58	2	<b>16</b>	13	6	3	5	10	-	-	1	-	-	1	-	-	1
00Duck	48	4	10	<b>6</b>	6	2	9	10	1	-	-	-	-	-	-	-	-
01Hamma	56	2	6	12	<b>11</b>	2	9	13	-	-	-	-	-	-	1	-	-
01Lilli	53	1	1	1	7	<b>27</b>	7	7	-	1	-	1	-	-	-	-	-
92Quil	50	2	5	3	4	4	<b>12</b>	20	-	-	-	-	-	-	-	-	-
97Quil	54	2	6	8	7	1	9	<b>20</b>	-	-	-	-	-	-	-	-	1
00SalSno	60	1	-	-	-	-	1	-	<b>53</b>	5	-	-	-	-	-	-	-
01Jimmy	60	-	-	-	-	-	-	-	6	<b>54</b>	-	-	-	-	-	-	-
98HoodH	52	1	-	1	-	-	-	-	1	-	<b>34</b>	15	-	-	-	-	-
98Dewatt	59	-	-	1	-	2	-	-	1	-	21	<b>25</b>	-	1	2	4	2
02Mission	18	1	-	-	1	-	-	1	-	-	1	4	<b>9</b>	-	-	1	-
94JohnsC	55	1	1	-	-	-	-	-	-	-	1	2	-	<b>34</b>	6	7	3
94Sherwo	55	-	1	-	-	1	-	-	1	-	4	-	-	9	<b>25</b>	4	10
94Coulter	56	1	-	-	1	-	-	-	-	-	2	3	-	14	8	<b>21</b>	6
96Black	41	-	-	-	-	-	-	-	-	-	-	-	-	3	5	1	<b>32</b>
Total	829																
Sample size		54	58	48	56	52	50	54	60	60	52	59	18	55	55	56	41
correct classifications		52	16	6	11	27	12	20	53	54	34	25	9	34	25	21	32
% correct classifications		96.3	27.6	12.5	19.6	51.9	24.0	37.0	88.3	90.0	65.4	42.4	50.0	61.8	45.5	37.5	78.0
Expected correct		6.5	7.0	5.8	6.8	6.3	6.0	6.5	7.2	7.2	6.3	7.1	2.2	6.6	6.6	6.8	5.0
$\chi^2$		<b>1235.8</b>	60.5	7.8	24.5	<b>331.7</b>	53.4	<b>142.8</b>	<b>907.4</b>	<b>945.0</b>	<b>556.2</b>	<b>174.4</b>	<b>1052.2</b>	<b>458.3</b>	<b>226.8</b>	<b>139.7</b>	<b>1079.1</b>

Table 5. Regional assignment test using WHICHRUN. In the regional collection section, collections were grouped by region before assignments. The Hood Canal only section reports results when only Hood Canal summer (HCS) collections were analyzed, Hood Canal and SJF reports results when Hood Canal summer and SJF were analyzed together. Assignments to origin and significant  $\chi^2$  values ( $P < 0.05$ ) are in bold.

Regional collections	HCS	SJFS	SPSS	HCF	All
HCS	<b>364</b>	2	4	3	373
SJFS	2	<b>118</b>	0	0	120
SPSS	6	1	<b>188</b>	12	207
HCF	8	2	10	<b>109</b>	129
Sample size	373	120	207	129	
Correct observed	364	118	188	109	
% correct	97.6	98.3	90.8	84.5	
Correct expected	45.0	14.5	25.0	15.6	
$\chi^2$	<b>61.5</b>	<b>485.8</b>	<b>173.7</b>	<b>305.4</b>	

Hood Canal only	00Union	00Dosewa	00Duckab	01HammaH	01Lilliw	92Quil	97Quil	All
00Union	<b>52</b>			1	1			54
00Dosewa	2	<b>18</b>	14	6	3	5	10	58
00Duckab	4	11	<b>6</b>	6	2	9	10	48
01HammaH	2	6	12	<b>12</b>	2	9	13	56
01Lilliw	1	2	1	7	<b>27</b>	8	7	53
92Quil	2	5	3	4	4	<b>12</b>	20	50
97Quil	2	7	8	7	1	9	<b>20</b>	54
Sample size	54	58	48	56	53	50	54	
Correct observed	52	18	6	12	27	12	20	
% correct	96.3	31.0	12.5	21.4	50.9	24.0	37.0	
Correct expected	14.5	15.5	12.9	15.0	14.2	13.4	14.5	
$\chi^2$	<b>462.4</b>	15.4	0.0	2.7	<b>95.0</b>	8.4	35.2	

Hood Canal and SJF	00Union	00Dosewa	00Duckab	01HammaH	01Lilliw	92Quil	97Quil	00Sal/Sno	01Jimmy
00Union	<b>52</b>			1	1				54
00Dosewa	2	<b>18</b>	14	6	3	5	10		58
00Duckab	4	11	<b>6</b>	6	2	9	10	1	49
01HammaH	2	6	12	<b>12</b>	2	9	13		56
01Lilliw	1	2	1	7	<b>27</b>	8	7		54
92Quil	2	5	3	4	4	<b>12</b>	20		50
97Quil	2	7	8	7	1	9	<b>20</b>		54
00Sal/Sno	1					1		<b>53</b>	5
01Jimmy								6	<b>54</b>
Sample size	54	58	49	56	54	50	54	60	60
Correct observed	52	18	6	12	27	12	20	53	54
% correct	96.3	31.0	12.2	21.4	50.0	24.0	37.0	88.3	90.0
Correct expected	10.9	11.7	9.9	11.3	10.9	10.1	10.9	12.1	12.1
$\chi^2$	<b>668.3</b>	31.8	0.6	9.0	<b>140.1</b>	19.1	62.6	<b>479.2</b>	<b>500.4</b>

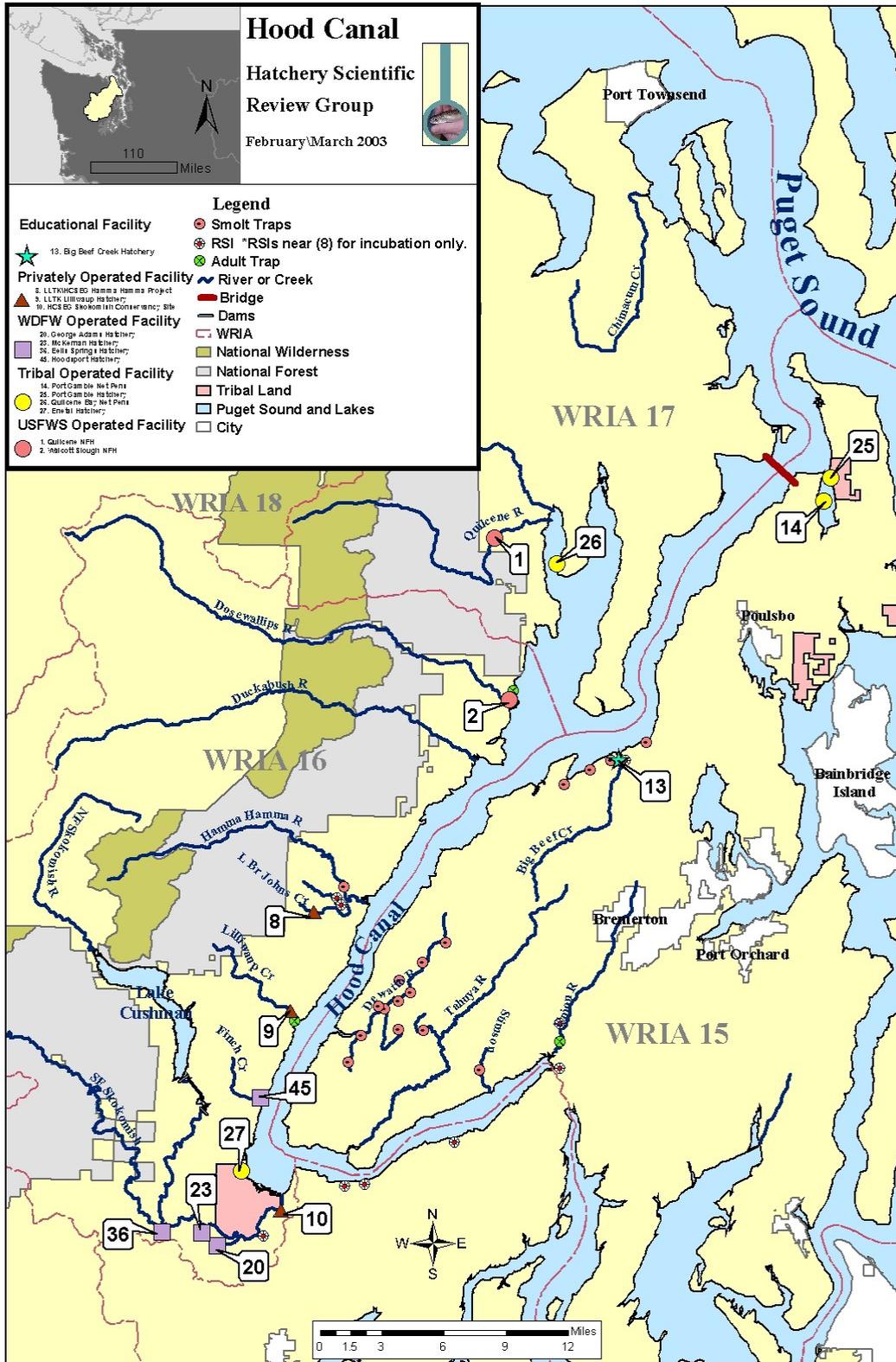


Figure 1. Map of Hood Canal, Strait of Juan de Fuca and portions of Puget Sound. Map was generated by Gil Lensegrav, WDFW.

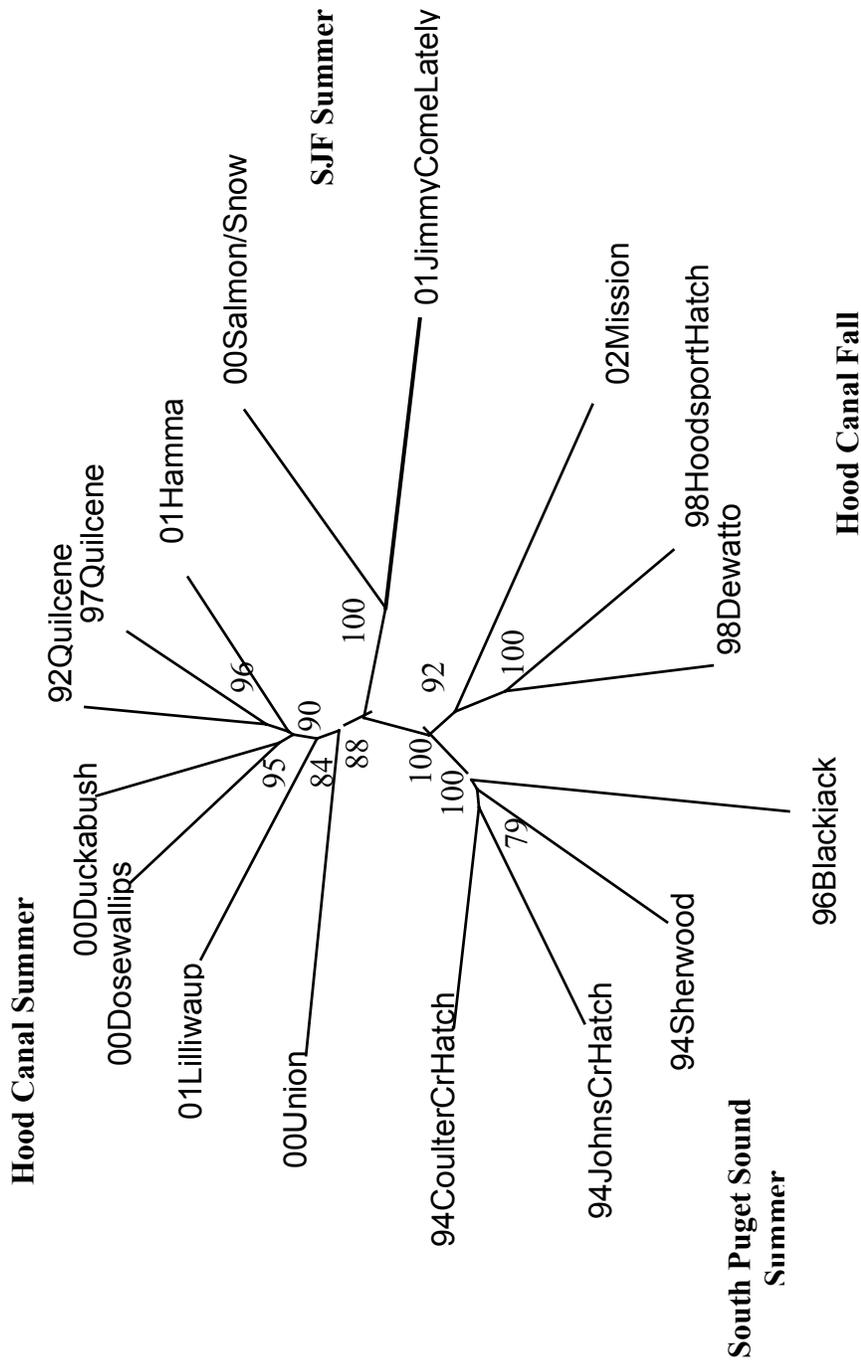


Figure 2. Neighbor-joining tree showing genetic distances among collections and bootstrap support for groupings on the tree. The numbers at the nodes are the percentage of 10,000 trees in which the collections grouped together. Strait of Juan de Fuca is abbreviated "SJF".

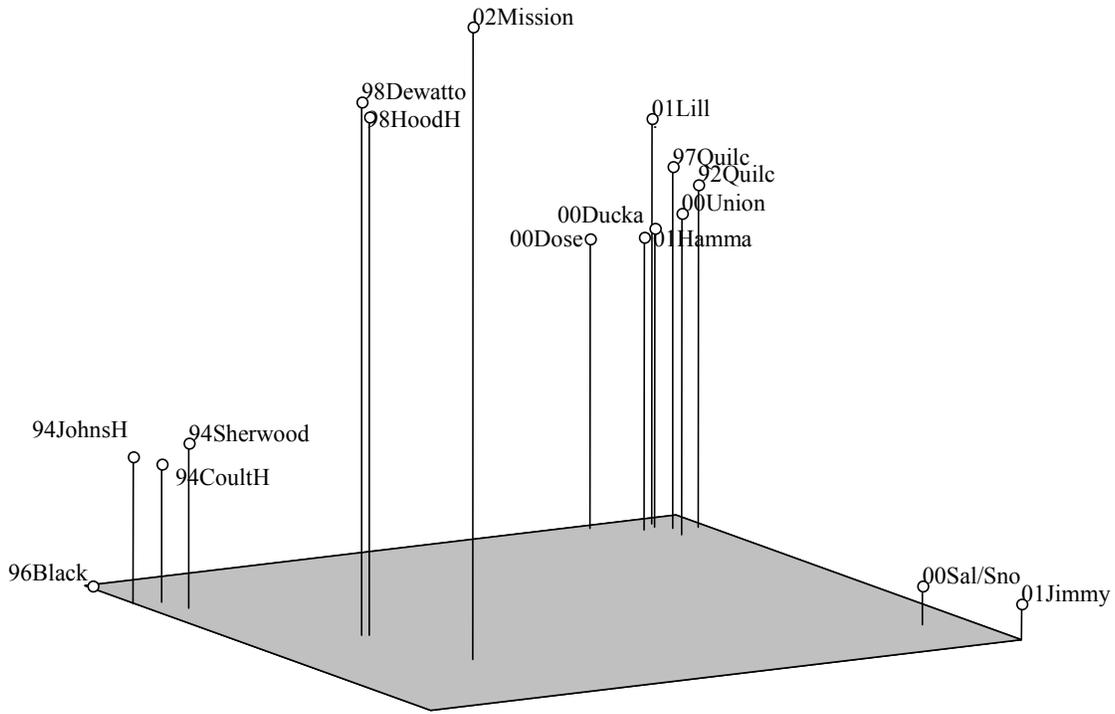


Figure 3. Multidimensional scaling plot of Cavalli-Sforza and Edwards distances among collections.



# APPENDIX REPORT 5

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## **STATUS OF ARTIFICIAL PRODUCTION PROGRAMS IN MEETING SPECIFIED MITIGATION MEASURES TO REDUCE RISK OF NEGATIVE INTERACTIONS WITH SUMMER CHUM SALMON**

The Summer Chum Salmon Conservation Initiative (section 3.3.2.1) specifies risk aversion and monitoring/evaluation measures to be met by artificial production programs that have medium to high risk of hazards affecting summer chum. These mitigation measures are described in four categories: hatchery operations, predation, competition and behavior modification, and fish disease transfer. Following is a progress report on the status of the artificial production programs in meeting the mitigation measures in 2001 and 2002 (information for 2003 was not yet available at the time this appendix was prepared). Unless otherwise specified, the below comments on status apply to both years. The status of mitigation measures for years 1999 and 2000 was reported in Supplementation Report No. 3 (WDFW and PNPTT 2001).

The artificial production programs and mitigation measures are presented in the following format.

### **Species**

#### ***Project***

Sponsor

Release Class

Hazard Category

Mitigation Measures

Status

The order of artificial production programs (projects) and the specified mitigation measures follow the order of information shown in Table 3.1 that summarizes the status of mitigation measures in the main body of the present report. The risk aversion and monitoring/evaluation measures are represented by the abbreviations “r.a.” and “m&e”, respectively. The symbols “(Y)”, “(N)”, “(Y/N)” and “(NA)” are used in describing status of the mitigation measures and indicate (Y)es, (N)o, (Y)es and (N)o, or (N)ot (A)pplicable with respect to implementation of the measures. The (Y/N) designation means the measure was only partially implemented. Explanatory comments regarding implementation of the measures for the specific projects are provided in the following project status reports.

## Fall Chinook Salmon

### *Project: Big Beef Creek Chinook*

Sponsors: University of Washington (UW) and Hood Canal Salmon Enhancement Group (HCSEG)  
with WDFW

Release Class: Fingerling

#### Hatchery Operations

##### Specified Mitigation Measures:

m&e #3: Fish health monitoring

m&e #4: Recording of fish production (release data)

m&e #5: NPDES permit effluent monitoring

##### Status:

m&e #3: **(Y/N)** Certification of brood stocks conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #4: **(N)** Report not submitted to WDFW. To improve reporting in the future, contract will stipulate that continuation of project requires report to be provided. WDFW will also follow up by working directly with project operator.

m&e #5: **(NA)** Not applicable - no NPDES required for project of this size.

#### Predation

##### Specified Mitigation Measure:

m&e #1: Recording of fish production (release data)

##### Status:

m&e #1: **(N)** Report not submitted to WDFW. To improve reporting in the future, contract will stipulate that continuation of project requires report to be provided. WDFW will also follow up by working directly with project operator.

#### Competition and Behavior Modification:

##### Specified Mitigation Measures:

r.a #4: Capture 100% of returning fall chinook to reduce risk of spawning ground space competition with summer chum.

m&e #1: Monitor returning fall chinook that spawn naturally for impact on summer chum.

##### Status:

r.a #4: **(N)** Report not submitted to WDFW. To improve reporting in the future, contract will stipulate that continuation of project requires report to be provided. WDFW will also follow up by working directly with project operator.

m&e #1: **(N)** Report not submitted to WDFW. To improve reporting in the future, contract will stipulate that continuation of project requires report to be provided. WDFW will also follow up by working directly with project operator.

**Project: Big Beef Creek Chinook (cont.)**

Disease Transfer

Specified Mitigation Measures:

r.a #1: Monitoring and evaluation of brood stock and juvenile fish health by fish health professionals.

r.a #2: Follow Co-managers' salmonid disease control policy.

r.a #3: Fish health certification before release.

r.a #4: Release fish in healthy condition.

m&e #1: Monitoring and evaluation of brood stock and juvenile fish health by fish health professionals (same as r.a #1).

m&e #2: Report fish health and condition.

Status:

r.a #1: (Y/N) Certification of brood stock conducted in WDFW Virology Lab.

Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

r.a #2: (Y) Ensured by WDFW fish pathologists, if fish health checks needed.

r.a #3: (N) Not certified by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

r.a #4: (Y) Ensured by WDFW fish pathologists, if fish health checks needed.

m&e #1: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #2: (Y) Reporting done by WDFW fish pathologists, if needed.

**Project: Skokomish R. Chinook (Enhancement Group)**

Sponsors: HCSEG/WDFW/Long Live the Kings

Release Classes: Fingerling and Yearling

Hatchery Operations

Specified Mitigation Measures:

m&e #3: Fish health monitoring.

m&e #4: Recording of fish production (release data).

m&e #5: NPDES permit effluent monitoring.

Status:

m&e #3: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Yearling fish health checked prior to release. Fingerling fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #4: (Y/N) Report submitted to WDFW in 2002 but not 2001.

m&e #5: (NA) Not applicable - no NPDES required for project of this size.

Predation

Specified Mitigation Measure:

m&e #1: Recording of fish production (release data)

**Project: Skokomish R. Chinook (Enhancement Group) (cont.)**

Status:

m&e #1: (Y/N) Report submitted to WDFW in 2002 but not 2001.

Competition and Behavior Modification:

Specified Mitigation Measure:

m&e #1: Monitor returning fall chinook that spawn naturally for impact on summer chum.

Status:

m&e #1: (Y) Potential effects require more information on status of Skokomish summer chum stock.

Disease Transfer

Specified Mitigation Measures:

m&e #1: Monitoring and evaluation of brood stock and juvenile fish health by fish health professionals.

m&e #2: Report fish health and condition.

Status:

m&e #1: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Yearling fish health checked prior to release. Fingerling fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #2: (Y) Reporting done by WDFW fish pathologists, if needed.

**Project: Hamma Hamma R. Chinook**

Sponsors: HCSEG/WDFW

Release Classes: Fingerling

Hatchery Operations

Specified Mitigation Measures:

r.a. #4: Handling and holding of summer chum brood stock minimized.

r.a. #6: Brood stocking and hatchery operations consistent with provisions of the SCSCI.

m&e #1: Daily recording of numbers captured, disposition and mortalities during adult trapping operations. Provide data reports to WDFW.

m&e #2: Record keeping of brood stocking. Provide reports to WDFW.

m&e #3: Fish health monitoring

m&e #4: Recording of fish production (release data)

m&e #5: NPDES permit effluent monitoring

Status:

r.a. #4: (Y) Trapping of returning adult summer chum was effective with low impact.

r.a. #6: (Y) Operations consistent with SCSCI.

m&e #1: (Y) Records kept and provided to WDFW.

m&e #2: (Y) Records kept and provided to WDFW.

***Project: Hamma Hamma R. Chinook*** (cont.)

m&e #3: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #4: (Y) Report submitted to WDFW.

m&e #5: (NA) Not applicable - no NPDES required for project of this size.

Predation

Specified Mitigation Measure:

m&e #1: Recording of fish production (release data)

Status:

m&e #1: (Y) Report submitted to WDFW.

Competition and Behavior Modification:

Specified Mitigation Measure:

m&e #1: Monitor returning fall chinook that spawn naturally for impact on summer chum.

Status:

m&e #1: (Y) Information submitted to WDFW.

Disease Transfer

Specified Mitigation Measures:

m&e #1: Monitoring and evaluation of brood stock and juvenile fish health by fish health professionals.

m&e #2: Report fish health and condition.

Status:

m&e #1: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #2: (Y) Reporting done by WDFW fish pathologists, if needed.

## **Chinook Salmon**

***Project: Dungeness Fish Hatchery Chinook***

Sponsors: WDFW

Release Classes: Fry, Fingerling

Predation

Specified Mitigation Measure:

m&e #2: Monitor chinook survival rates, distribution within stream and potential predation effects on summer chum.

Status:

m&e #2: (Y) Fingerling survival rates monitored by CWT. Distribution within stream may be assessed through Jamestown S'Klallam Tribe's life history studies.

***Project: Dungeness Fish Hatchery Chinook*** (cont.)

Potential predation effects require more information on status of Dungeness summer chum stock.

## **Coho Salmon**

***Project: Port Gamble Net Pens Coho***

Sponsors: Port Gamble S'Klallam Tribe with WDFW and USFWS

Release Classes: Yearling

Competition and Behavior Modification:

Specified Mitigation Measure:

r.a. #7: Acclimate coho to release site.

Status:

r.a. #7: (Y) Coho were acclimated to the Port Gamble site for at least three months before release.

***Project: Quilcene Net Pens Coho***

Sponsors: Skokomish Tribe with WDFW and USFWS

Release Classes: Yearling

Competition and Behavior Modification:

Specified Mitigation Measure:

r.a. #7: Acclimate coho to release site.

Status:

r.a. #7: (Y) Coho were acclimated to the Quilcene Bay site for at least three months before release.

***Project: Snow Creek Coho***

Sponsor: WDFW

Release Classes: Unfed Fry, Pre-smolts

Predation

Specified Mitigation Measure:

m&e #2: Monitor coho survival rates, distribution within stream and potential predation effects on summer chum.

Status:

m&e #2: (Y) Survival rates monitored by CWT and/or otolith marks. Fry releases from RSIs monitored for distribution in stream and at trap at RM 0.8 as smolts. Potential predation effects of coho smolts on summer chum not monitored, but presumed to be minimal due to differential outmigration timing of coho smolts (mid-April through May) vs. summer chum (March-April).

Competition and Behavior Modification:

Specified Mitigation Measure:

**Project: Snow Creek Coho** (cont.)

m&e #3: Monitor coho survival rates, distribution within stream and potential competition effects on summer chum.

Status:

m&e #3: (Y) Survival rates monitored by CWT and/or otolith marks. Fry releases from RSIs monitored for distribution in stream and at trap at RM 0.8 as smolts. Potential predation effects of coho smolts on summer chum not monitored, but presumed to be minimal due to differential outmigration timing of coho smolts (mid-April through May) vs. summer chum (March-April).

## **Pink Salmon**

**Project: Hoodspout Fish Hatchery Pink**

Sponsor: WDFW

Release Classes: Fed Fry

Predation

Specified Mitigation Measure:

r.a. #4: Release pink fry after April 1 to reduce risk of predator attraction to summer chum fry in estuarine areas.

Status:

r.a #4: (Y) Pink fry released after April 1.

Competition and Behavior Modification:

Specified Mitigation Measure:

r.a.#1&#2: No pink release (fed or unfed fry) before April 1 to reduce risk of food source competition and adverse behavior modification effects on summer chum in estuarine areas.

Status:

r.a. #1&#2: (Y) All pink fry released after April 1.

**Project: Dungeness Fish Hatchery Fall Pink**

Sponsor: WDFW

Release Classes: Fed Fry

Hatchery Operations

Specified Mitigation Measures:

r.a #1: Minimize handling and delay of summer chum by weir used to capture fall pinks.

r.a. #2: Personnel operating weir are properly trained in handling of summer chum.

r.a. #3: Monitor weir continuously.

r.a. #4: Hold summer chum captured at weir no longer than four hours before passing upstream.

***Project: Dungeness Fish Hatchery Fall Pink (cont.)***

r.a. #5: Place and remove weir with no impact on spawning activities, distribution or redds of summer chum.

Status:

r.a. #1-5: (Y) The weir was place and removed in 2001 with no discernable effect on spawning activities, distribution or redds of summer chum. Weir not used in non-pink (even-numbered) years such as 2002.

Competition and Behavior Modification:

Specified Mitigation Measure:

r.a. #6: Release pink fry after April 1.

Status:

r.a. #6: (Y) Pink fry released after April 1.

## **Fall Chum Salmon**

***Project: Hoodspport Fish Hatchery Fall Chum***

Sponsor: WDFW

Release Classes: Fed Fry

Predation

Specified Mitigation Measure:

r.a. #4: Release fall chum fry after April 1 to reduce risk of predator attraction to summer chum fry in estuarine areas.

Status:

r.a #4: (Y) Fall chum fry released after April 1.

Competition and Behavior Modification:

Specified Mitigation Measures:

r.a.#1&#2: No fall chum release (fed or unfed fry) before April 1 to reduce risk of food source competition and adverse behavior modification effects on summer chum in estuarine areas.

Status:

r.a. #1&#2: (Y) All fall chum fry released after April 1.

***Project: McKernan Fish Hatchery Fall Chum***

Sponsor: WDFW

Release Classes: Fed Fry

Predation

Specified Mitigation Measure:

r.a. #4: Release fall chum fry after April 1 to reduce risk of predator attraction to summer chum fry in estuarine areas.

**Project: McKernan Fish Hatchery Fall Chum (cont.)**

Status:

r.a #4: (Y) Fall chum fry released after April 1.

Competition and Behavior Modification:

Specified Mitigation Measures:

r.a.#1&#2: No fall chum release (fed or unfed fry) before April 1 to reduce risk of food source competition and adverse behavior modification effects on summer chum in estuarine areas.

Status:

r.a. #1&#2: (Y) All fall chum fry released after April 1.

**Project: Sweetwater Creek Fall Chum**

Sponsor: HCSEG/WDFW

Release Classes: Unfed Fry

Hatchery Operations

Specified Mitigation Measures:

m&e #3: Fish health monitoring  
m&e #4: Recording of fish production (release data)  
m&e #5: NPDES permit effluent monitoring

Status:

m&e #3: (Y/N) Certification of brood stocks conducted in WDFW Virology Lab. Fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #4: (Y) Report that addressed fish production provided to WDFW.

m&e #5: (NA) Not applicable - no NPDES required for project of this size.

Predation

Specified Mitigation Measure:

m&e #1: Recording of fish production (release data)

Status:

m&e #1: (Y) Report that addressed fish production submitted to WDFW.

Competition and Behavior Modification:

Specified Mitigation Measures:

r.a. #2: No fall chum release before April 1 to reduce risk of food source competition and adverse behavior modification effects on summer chum in estuarine areas.

m&e #2: Monitor timing of emergence and numbers of fry released

Status:

r.a. #2: (Y) All fall chum fry released after April 1.

m&e #2: (Y) Timing and numbers of fry released monitored but not reported.

**Project: Sweetwater Creek Fall Chum (cont.)**

Disease Transfer

Specified Mitigation Measures:

r.a #1: Monitoring and evaluation of brood stock and juvenile fish health by fish health professionals.

r.a #2: Follow Co-managers' salmonid disease control policy.

r.a #3: Fish health certification before release.

r.a #4: Release fish in healthy condition.

m&e #1: Monitoring and evaluation of brood stock and juvenile fish health by fish health professionals (same as r.a #1).

m&e #2: Report fish health and condition.

Status:

r.a #1:(Y/N) Certification of brood stock conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

r.a #2: (Y) Ensured by WDFW fish pathologists, if fish health checks needed.

r.a #3: (N) Not certified by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

r.a #4: (Y) Ensured by WDFW fish pathologists, if fish health checks needed.

m&e #1: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #2: (Y) Reporting done by WDFW fish pathologists, if needed.

**Project: Unnamed Creek 14.0124 (Grimm) Fall Chum**

Sponsor: HCSEG/WDFW

Release Classes: Unfed Fry

Hatchery Operations

Specified Mitigation Measures:

m&e #3: Fish health monitoring

m&e #4: Recording of fish production (release data)

m&e #5: NPDES permit effluent monitoring

Status:

m&e #3: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #4: (Y) Report that addressed fish production provided to WDFW.

m&e #5: (NA) Not applicable - no NPDES required for project of this size.

Predation

Specified Mitigation Measure:

m&e #1: Recording of fish production (release data)

Status:

m&e #1: (Y) Report that addressed fish production provided to WDFW.

**Project: Unnamed Creek 14.0124 (Grimm) Fall Chum** (cont.)

Competition and Behavior Modification:

Specified Mitigation Measures:

r.a. #2: No fall chum release before April 1 to reduce risk of food source competition and adverse behavior modification effects on summer chum in estuarine areas.

m&e #2: Monitor timing of emergence and numbers of fry released

Status:

r.a. #2: (Y) All fall chum fry released after April 1.

m&e #2: (Y) Timing and numbers of fry released monitored but not reported.

Disease Transfer

Specified Mitigation Measures:

r.a #1: Monitoring and evaluation of brood stock and juvenile fish health by fish health professionals.

r.a #2: Follow Co-managers' salmonid disease control policy.

r.a #3: Fish health certification before release.

r.a #4: Release fish in healthy condition.

m&e #1: Monitoring and evaluation of brood stock and juvenile fish health by fish health professionals (same as r.a #1).

m&e #2: Report fish health and condition.

Status:

r.a #1:(Y/N) Certification of brood stock conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

r.a #2: (Y) Ensured by WDFW fish pathologists, if fish health checks needed.

r.a #3: (N) Not certified by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

r.a #4: (Y) Ensured by WDFW fish pathologists, if fish health checks needed.

m&e #1: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #2: (Y) Reporting done by WDFW fish pathologists, if needed.

**Project: Unnamed Creek 14.0124 (Mulberg) Fall Chum**

Sponsor: HCSEG/WDFW

Release Classes: Unfed Fry

Hatchery Operations

Specified Mitigation Measures:

m&e #3: Fish health monitoring

m&e #4: Recording of fish production (release data)

m&e #5: NPDES permit effluent monitoring

**Project: Unnamed Creek 14.0124 (Mulberg) Fall Chum (cont.)**

Status:

m&e #3: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #4: (Y) Report that addressed fish production provided to WDFW.

m&e #5: (NA) Not applicable - no NPDES required for project of this size.

Predation

Specified Mitigation Measure:

m&e #1: Recording of fish production (release data)

Status:

m&e #1: (Y) Report that addressed fish production provided to WDFW.

Competition and Behavior Modification:

Specified Mitigation Measures:

r.a. #2: No fall chum release before April 1 to reduce risk of food source competition and adverse behavior modification effects on summer chum in estuarine areas.

m&e #2: Monitor timing of emergence and numbers of fry released

Status:

r.a. #2: (Y) All fall chum fry released after April 1.

m&e #2: (Y) Timing and numbers of fry released monitored but not reported.

Disease Transfer

Specified Mitigation Measures:

r.a #1: Monitoring and evaluation of juvenile fish health by fish health professionals.

r.a #2: Follow Co-managers' salmonid disease control policy.

r.a #3: Fish health certification before release.

r.a #4: Release fish in healthy condition.

m&e #1: Monitoring and evaluation of juvenile fish health by fish health professionals (same as r.a #1).

m&e #2: Report fish health and condition.

Status:

r.a #1:(Y/N) Certification of brood stock conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

r.a #2: (Y) Ensured by WDFW fish pathologists, if fish health checks needed.

r.a #3: (N) Not certified by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

r.a #4: (Y) Ensured by WDFW fish pathologists, if fish health checks needed.

m&e #1: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no

**Project: Unnamed Creek 14.0124 (Mulberg) Fall Chum (cont.)**

fish health problems occurred which required monitoring.

m&e #2: (Y) Reporting done by WDFW fish pathologists, if needed.

**Project: Unnamed Creek 14.0136 (Hood Canal Schools) Fall Chum**

Sponsor: HCSEG/WDFW

Release Classes: Unfed Fry

Hatchery Operations

Specified Mitigation Measures:

m&e #3: Fish health monitoring

m&e #4: Recording of fish production (release data)

m&e #5: NPDES permit effluent monitoring

Status:

m&e #3: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #4: (Y) Report that addressed fish production provided to WDFW.

m&e #5: (NA) Not applicable - no NPDES required for project of this size.

Predation

Specified Mitigation Measure:

m&e #1: Recording of fish production (release data)

Status:

m&e #1: (Y) Report that addressed fish production provided to WDFW.

Competition and Behavior Modification:

Specified Mitigation Measures:

r.a. #2: No fall chum release before April 1 to reduce risk of food source competition and adverse behavior modification effects on summer chum in estuarine areas.

m&e #2: Monitor timing of emergence and numbers of fry released

Status:

r.a. #2: (Y) All fall chum fry released after April 1.

m&e #2: (Y) Timing and numbers of fry released monitored but not reported.

Disease Transfer

Specified Mitigation Measures:

r.a #1: Monitoring and evaluation of brood stock and juvenile fish health by fish health professionals.

r.a #2: Follow Co-managers' salmonid disease control policy.

r.a #3: Fish health certification before release.

r.a #4: Release fish in healthy condition.

**Project: Unnamed Creek 14.0136 (Hood Canal Schools) Fall Chum (cont.)**

m&e #1: Monitoring and evaluation of brood stock and juvenile fish health by fish health professionals (same as r.a #1).

m&e #2: Report fish health and condition.

Status:

r.a #1:(Y/N) Certification of brood stock conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

r.a #2: (Y) Ensured by WDFW fish pathologists, if fish health checks needed.

r.a #3: (N) Not certified by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

r.a #4: (Y) Ensured by WDFW fish pathologists, if fish health checks needed.

m&e #1: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #2: (Y) Reporting done by WDFW fish pathologists, if needed.

## Steelhead

**Project: Skokomish R. Steelhead**

Sponsor: WDFW

Release Classes: Yearling

Predation

Specified Mitigation Measure:

r.a. #1: No yearling releases before April 15 to reduce risk of predation on summer chum fry. Pursue coefficient of variation for smolt length not to exceed 10%.

r.a. #2: No release of fry, fingerlings or sub-yearlings into summer chum streams.

r.a. #3: Volitionally-migrating and acclimated releases.

Status:

r.a. #1: (Y) Yearlings released after April 15.

r.a. #2: (Y) No fry, fingerlings or sub-yearlings released.

r.a. #3: (Y) Volitionally-migrating and acclimated yearlings released.

**Project: Dosewallips R. Steelhead**

Sponsor: WDFW

Release Classes: Yearling

Predation

Specified Mitigation Measure:

r.a. #1: No yearling releases before April 15 to reduce risk of predation on summer chum fry. Pursue coefficient of variation for smolt length not to exceed 10%.

**Project: Dosewallips R. Steelhead (cont.)**

- r.a. #2: No release of fry, fingerlings or sub-yearlings into summer chum streams.
- r.a. #3: Volitionally-migrating and acclimated releases.

Status:

- r.a. #1: (Y) Yearlings released after April 15.
- r.a. #2: (Y) No fry, fingerlings or sub-yearlings released.
- r.a. #3: (Y/N) Volitionally-migrating yearlings released. No facilities for acclimation currently exist.

**Project: Duckabush R. Steelhead**

Sponsor: WDFW

Release Classes: Yearling

Predation

Specified Mitigation Measure:

- r.a. #1: No yearling releases before April 15 to reduce risk of predation on summer chum fry. Pursue coefficient of variation for smolt length not to exceed 10%.
- r.a. #2: No release of fry, fingerlings or sub-yearlings into summer chum streams.
- r.a. #3: Volitionally-migrating and acclimated releases.

Status:

- r.a. #1: (Y) Yearlings released after April 15.
- r.a. #2: (Y) No fry, fingerlings or sub-yearlings released.
- r.a. #3: (Y/N) Volitionally-migrating yearlings released. No facilities for acclimation currently exist.

**Project: Dungeness R. Steelhead**

Sponsor: WDFW

Release Classes: Yearling

Predation

Specified Mitigation Measure:

- r.a. #1: No yearling releases before April 15 to reduce risk of predation on summer chum fry. Pursue coefficient of variation for smolt length not to exceed 10%.
- r.a. #2: No release of fry, fingerlings or sub-yearlings into summer chum streams.
- r.a. #3: Volitionally-migrating and acclimated releases.

Status:

- r.a. #1: (Y) Yearlings released after April 15.
- r.a. #2: (Y) No fry, fingerlings or sub-yearlings released.
- r.a. #3: (Y) Volitionally-migrating yearlings released. Fish are acclimated at Dungeness Hatchery before release.

**Project: Hamma Hamma R. Steelhead**

Sponsors: HCSEG/Long Live the Kings/WDFW/NMFS

Release Classes: Two-year smolt

Hatchery Operations

Specified Mitigation Measures:

r.a. #4: Handling and holding of summer chum brood stock minimized.

r.a. #6: Brood stocking and hatchery operations consistent with provisions of the SCSCI.

m&e #1: Daily recording of numbers captured, disposition and mortalities during adult trapping operations. Provide data reports to WDFW.

m&e #2: Record keeping of brood stocking. Provide reports to WDFW.

m&e #3: Fish health monitoring

m&e #4: Recording of fish production (release data)

m&e #5: NPDES permit effluent monitoring

Status:

r.a. #4: (Y) Timing and approach (collecting portion of eggs from steelhead redds) does not affect summer chum.

r.a. #6: (Y) Operations consistent with SCSCI.

m&e #1: (Y) Records kept and provided to WDFW.

m&e #2: (Y) Records kept and provided to WDFW.

m&e #3: (Y/N) Certification of brood stock conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #4: (Y) Report submitted to WDFW.

m&e #5: (NA) Not applicable - no NPDES required for project of this size.

Predation

Specified Mitigation Measure:

r.a. #1: No yearling releases before April 15 to reduce risk of predation on summer chum fry. Pursue coefficient of variation for smolt length not to exceed 10%.

r.a. #2: No release of fry, fingerlings or sub-yearlings into summer chum streams.

r.a. #3: Volitionally-migrating and acclimated releases.

m&e #1: Recording of fish production (release data)

Status:

r.a. #1: (Y/N) Two-year smolts were released after April 15. However, some sub-yearlings and yearlings escaped from natural pond into John Creek. Attempts to solve the problem by modifying the pond have failed. Production is to be transferred to a more secure pond at the site.

r.a. #2: (Y/N) No fry, fingerlings or sub-yearlings were intended for release as part of program. However, some sub-yearlings and yearlings escaped from natural pond into John Creek. Attempts to solve the problem by modifying the pond have failed. Production is to be transferred to a more secure pond at the site.

***Project: Hamma Hamma R. Steelhead*** (cont.)

r.a. #3: (Y) Volitionally-migrating and acclimated yearlings released. However, as noted above, some sub-yearlings and yearlings escaped from natural pond into John Creek

m&e #1: (Y) Report submitted to WDFW.

Competition and Behavior Modification:

Specified Mitigation Measure:

m&e #3: Monitor smolts resulting from planting of indigenous fry and fingerlings for survival rates and for distribution within stream. Also, evaluate potential competition effects on summer chum.

Status:

m&e #3: (NA) No fry or fingerling steelhead intentionally released in stream.

Disease Transfer

Specified Mitigation Measures:

m&e #1: Monitoring and evaluation of brood stock and juvenile fish health by fish health professionals.

m&e #2: Report fish health and condition.

Status:

m&e #1: (Y/N) Certification of brood stocks conducted in WDFW Virology Lab. Juvenile fish health was not checked by WDFW fish pathologists; however, no fish health problems occurred which required monitoring.

m&e #2: (Y) Reporting done by WDFW fish pathologists, if needed.



# **APPENDIX REPORT 6**

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## **INVESTIGATIONS OF HARBOR SEAL PREDATION ON SALMONIDS IN HOOD CANAL, WASHINGTON 1998-2001**

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### **Introduction**

Since the fall of 1998, the Washington Department of Fish and Wildlife (WDFW) and Washington Cooperative Fish and Wildlife Research Unit (WACFWRU) have conducted research to investigate potential impacts of harbor seal predation on recovering ESA-listed salmonid populations in Hood Canal, Washington. Funding for this research has been provided by the National Marine Fisheries Service (NMFS) through the Pacific States Marine Fisheries Commission (PSMFC). This research is part of a coordinated effort to investigate impacts of seals and sea lions on west coast salmonids and marine ecosystems in California, Oregon and Washington. The following summary includes estimated predation rates and seal diet data collected from the mouths of various Hood Canal river systems during the fall of 1998-2001. A detailed description of sampling methodology, analysis and results from 1998-2000 can be found in London et al. 2001.

### **Total Salmon Predation Estimates**

In 1998 and 1999, daytime surface observations to document seal predation on returning adult salmon were made at the mouths of the major river systems in Hood Canal including Quilcene Bay, Dosewallips River, Duckabush River, Hamma Hamma River and Skokomish River. In 2000, observations of seal predation on adult salmon were conducted at Quilcene Bay, Dosewallips River, Duckabush River and Hamma Hamma River. In 2001, observations focused only on the Dosewallips and Duckabush Rivers because estimates in 1998-2000 indicated the impact of seals on returning salmon in the Hamma Hamma River and Quilcene Bay was negligible. In addition, the Duckabush and Dosewallips Rivers provided more ideal viewing of seal predation. In 2000 and 2001, due to a lack of salmon run data at the Skokomish River, no harbor seal predation estimates were made for this site.

The estimated number of salmon taken by harbor seals is presented in Table 1 and includes estimates of daytime-only predation and estimates for predations extrapolated to a 24 hour day. The estimated number of salmon taken by harbor seals at each river fluctuated among years. Higher predation rates in 1999 and 2001 most likely reflect greater salmon abundance with the presence of pink salmon in odd years. Estimates for 24-hour harbor seal predation in 2000 and 2001 should be treated as preliminary with final estimates pending.

## **Night Predation Observations**

Nighttime predation observations at the Duckabush River were conducted in 2000 and 2001 using night vision goggles. A total of 12 night observations were conducted in 2001 at the Duckabush River. These observations were pooled with the paired observations from 2000 and compared with a paired t-test to assess the hypothesis of no difference in observed predations between day and night. Results of this analysis are presented in Table 2. In all cases, the null hypothesis of no difference was rejected. The mean number of predations at night was 1.88, while the mean number of predations during the day was 5.04. The mean number of foragers at night was 4.04 compared to 7.70 during the day. The extent to which these differences reflect the reduced visibility inherent to night observations compared to daytime is unknown, but likely significant. Further comparison of other behaviors such as pursuits, which are more easily observed at night, may prove a more beneficial analysis. Given the remaining uncertainty in our estimates of night predation, we feel it is prudent to continue reporting salmonid consumption estimates based on the assumption that the predation rate is the same during the day and night.

## **Scat Collection, Food Habits Analysis and Harbor Seal Diet**

Fecal sample (scat) collections were made each year during the same time window as predation observations at the mouths of each river at major seal haulouts. Sampling protocols and food habits analysis detail may be found in London et al. 2001 and Lance et al 2001. In 2000 and 2001, no scat collections were made at the Hamma Hamma River or Skokomish River because our focus shifted to northern rivers for predation observations. Scat collections in Quilcene Bay were made from the oyster rafts and salmon net pen off the west side of the Bolton Peninsula.

Quantifying salmon consumption was the primary focus of this study and identification of salmon remains in scat samples is one way to measure its importance in the diet of harbor seals. Salmon species are the third most commonly occurring prey species based on frequency of occurrence (27.4) in the diet over the entire sampling period and for all collection sites combined (Table 3). Genetic analysis of salmon bone for species identification is currently being conducted by WDFW's genetics lab.

## **Summary**

From 1998 to 2001, we conducted an intensive observation effort to estimate harbor seal predation on salmonids in Hood Canal. Sampling design for predation observations and investigation of diet using scat analysis was similar in all years, however knowledge and experience from previous years allowed us to focus our efforts in a most efficient manner and continue to expand our knowledge of the intricate relationship between harbor seals, salmon and the greater Hood Canal ecosystem. Pink salmon returns during the 1999 and 2001 field season likely influenced annual predation rates. When pink salmon runs are present in the Dosewallips and Duckabush Rivers, and given seal predation rates are likely linked to salmon abundance, we were not surprised to see an increase in overall predation compared to 1998 and 2000. However, the estimate of 1801 salmon predations at the Duckabush in 2001 is over three times greater than the estimated number of seal predations we had in our other pink year (1999). The ramifications of such a high level of predation will not be fully understood until abundance estimates for salmon are examined. As in past years, the relationship between more abundant salmon species such as pink and less abundant species like summer chum, and harbor seal prey selection will be critical to understanding the impact of seal predation on recovery of Hood Canal summer chum.

During 2001, we increased our effort to examine the differences in predation rates at night versus day. Our observations resulted in surprising differences in the mean number of foragers and mean number of predations. Both estimates were significantly lower at night. This suggests our assumption that predation rates observed during the day are representative of all 24 hours may not be appropriate. However, we are unable to accurately see all predations at night, and some of the difference can likely be attributed to our decreased visibility. We feel our ability to estimate number of foragers is better and were surprised to see the numbers were lower at night. The number of salmon consumed at night may be less than are consumed during the day, however, without an appropriate correction factor the more prudent approach is likely to assume a similar rate.

The importance of both Pacific hake and Pacific herring in the diet of harbor seals has remained consistent over all four years. Salmon species continues to be the third most frequently occurring prey species in the diet. We acknowledge biases associated with scat analysis and look towards genetic analysis of salmon bones and seal scats to help elucidate these questions.

The importance of understanding the role of harbor seals in the greater Hood Canal ecosystem has recently become more important as 13 mammal-eating transient killer whales spent more than 60 consecutive days foraging on harbor seals in Hood Canal in early 2003. For the 2003 field season, the potential ramifications of a *reduced* harbor seal population on salmon predation will be explored more fully. This perturbation to the system provides us with the unique opportunity to examine potential management options of reducing harbor seal predation to improve summer chum salmon recovery.

## References

Lance, M.M., A.J. Orr, S.D. Riemer, M.J. Weise, and J.L. Laake. 2001. Pinniped food habits and prey identification techniques protocol. AFSC Processed report 2001-04. NOAA/NMFS 7600 Sand Point Way N.E. Seattle, WA. 98115-0070. 36 p.

London, J.M., M.M. Lance and S.J. Jeffries. 2001. Observations of harbor seal predation on Hood Canal salmonids from 1998 to 2000. Final Report, Studies of expanding pinniped populations NOAA Grant No. NA17FX1603, WDFW, PSMFC contract No. 02-15. 20 p.

**Table 1.** Estimates of daytime and 24 hour harbor seal predation on salmon species in Hood Canal Rivers 1998-2001.

Observation dates	Total observation hours	Quilcene Bay	Dosewallips River	Duckabush River	Hamma Hamma River
<b>1998</b> (5 Sept - 20 Nov)	817				
Daytime		212	100	40	16
24 hr		414	202	84	27
<b>1999</b> (15 Aug - 11 Nov)	1,212				
Daytime		71	171	256	100
24 hr		134	336	482	190
<b>2000</b> (15 Aug - 29 Oct)	600				
Daytime		147	81	162	114
24 hr		305	218	441	250
<b>2001</b> (12 Aug - 1 Nov)	478				
Daytime		--	--	--	--
24 hr		--	264 <sup>1</sup>	1,801 <sup>1</sup>	--

<sup>1</sup> Only 24 hr estimate currently available.

**Table 2.** Results of paired t-test and means for day vs. night comparison of observations in 2000-01 (n=26).

	Mean	t-test	p value
Daytime Predations	5.04		
Nighttime Predations	1.88	Reject null	p<0.0001
Daytime Foragers	7.70		
Nighttime Foragers	4.04	Reject null	p<0.0001

**Table 3.** Percent frequency of occurrence (FO) of prey species identified using all structures (bone and otoliths) in harbor seal scat during fall 1998-2001 in Hood Canal, Washington (n = 1,997).

<b>Prey species</b>	<b>Number</b>	<b>FO</b>
Pacific hake	1500	75.1
Pacific herring	852	42.7
Salmon species	547	27.4
Shiner surfperch	194	9.7
Cephalopod species	139	7.0
Clupeid species	136	6.8
Gadid species	79	4.0
Threespine stickleback	78	3.9
Pacific tomcod	62	3.1
P. Staghorn sculpin	59	3.0
Plainfin midshipman	54	2.7
Northern anchovy	42	2.1
Skate (Family Rajidae)	19	1.0
Pile surfperch	17	0.9
Rockfish species	15	0.8
Pacific cod	8	0.4
Pacific sandlance	6	0.3
Pleuronectid species	5	0.3
Walleye pollock	4	0.2
Unidentified	102	5.1